THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 56 Thursday, June 10, 1937 No. 1086

PUBLISHED WEEKLY

Subscription Terms : 15s. per annum.
Foreign and Colonial : 17s. 6d. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, the Advertisement Manager, or the Publisher of

THE FOUNDRY TRADE JOURNAL
49, WELLINGTON STREET, LONDON, W.C.2

Telegraphic Address : "Zacatecas, Rand, London."
Telephone : Temple Bar 3951 (5 lines).

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF

The Institute of British Foundrymen

The Institute of Vitreous Enamellers

The Welsh Engineers' and Founders' Association

and

The Foundry Trades' Equipment and Supplies Association

Institute of British Foundrymen

PRESIDENT : 1937-38

C. W. Bigg, "Selworthy," Burley, Lane, Quardon, near Derby.

LIST OF SECRETARIES—

General Secretary : T. Makemson, Saint John Street Chambers, Deansgate, Manchester. London Office : 49, Wellington Street, London, W.C.2.
Birmingham, Coventry and West Midlands : A. A. Timmins, A.I.C., 21-23, St. Paul's Square, Birmingham.
East Midlands : B. Gale, "Parkdale," Boulton Lane, Alvaston, Derby.
Lancashire : J. E. Cooke, 1, Derbyshire Crescent, Stretford, Manchester.
London : R. Causebrooke, Thos. W. Ward, Limited, Thames Road, Silvertown, London, E.16.
Middlesbrough : D. R. Kinnell, Chas. P. Kinnell & Company, Limited, Vulcan Ironworks, Thornaby-on-Tees.
Newcastle-upon-Tyne : W. Scott, Sir W. G. Armstrong, Whitworth & Company (Ironfounders), Limited, Close Works, Gateshead-on-Tyne.
Scottish : J. Bell, 60, St. Enoch Square, Glasgow.
Sheffield : T. R. Walker, B.A., "The Priory," Oughtibridge, near Sheffield.
Wales and Monmouth : J. J. McClelland, 12, Clifton Place, Newport, Mon.
West Riding of Yorkshire : S. W. Wise, 110, Pullan Avenue, Ecclesshill, Bradford.

Bristol : A. Hares, Park Crescent, 648, Stapleton Road, Bristol.
Burnley : W. Haworth, 37, Westbourne Avenue, Burnley, Lancs.
East Anglian : J. L. Francis, 53, Cromer Road, Ipswich.
Falkirk : H. McNair, "Braewick," Larbert Road, Bonnybridge, Scotland.
Lincoln : E. R. Walter, M.Sc., The Technical College, Lincoln.
Preston : P. Leyland, 7, Ashley Terrace, Farington, Lancs

The Institute of Vitreous Enamellers

President : Dr. J. W. Mellor, F.R.S., Sandon House, Regent Street, Stoke-on-Trent.
Chairman : W. H. Whittle, W. H. Whittle, Limited, Eccles, near Manchester.
Hon. Secretary : Miss E. Christine Elliot, 49, Wellington Street, Strand, London, W.C.2.

Foundry Trades' Equipment and Supplies Association

President : A. C. Turner, Russell House, Adelphi, London, W.C.2.
Secretary : K. W. Bridges, Grand Buildings, Trafalgar Square, London, W.C.2.

Welsh Engineers' and Founders' Association

President : W. E. Clement, Morfa Foundry, New Dock, Llanelly.
Secretary : J. D. D. Davis, 9, Royal Metal Exchange, Swansea.

BRITISH CAST IRON RESEARCH ASSOCIATION

The Registered Office and Laboratories of the B.C.I.R.A. are :—
21-23, ST. PAUL'S SQUARE, BIRMINGHAM
Telephone: Central 1885. *Telegrams: CIRA*

The B.C.I.R.A. Scottish Laboratories are :—
Foundry Technical Institute, Meek's Road, Falkirk
Telephone: 332

Contents

	PAGE.
A New Phase of Waste Utilisation	457
The Value of Practical Experience—II	457
Notes from the Branches	458
Correspondence	458
The Derby Conference Fund	458
Random Shots	458
German Ironfounders' Association; Papers Presented to the Annual Meeting	459
International Foundry Congress in Paris	462
Foundry Problems	463
Testing Foundry Sands	463
Recommendations Concerning the Establishment of Costs in a Grey Iron Foundry	464
Publications Received	462, 466
Effect of Coke Size in Melting Cast Iron	467
Trends in the Non-Ferrous Foundry	470
Improved Treatment of Fractures	472
This Week's News in Brief	474
Trade Talk	474
Personal	474
Company Reports	474
Obituary	474
Patent Specifications Accepted	474
New Companies	474
Contracts Open	474
Forthcoming Event	474
Raw Material Markets	476

A New Phase of Waste Utilisation

We were intrigued with an advertisement which appeared in our last issue, as it described a phase of metallurgy of the utmost importance in times like the present, when there is a shortage of pig-iron and good melting scrap. There is a disclosure of a method for the economic utilisation of turnings as a raw material. The ordinary objections to this commodity as a raw material for the cupola are well known, and set out logically include the following:—(1) Difficulty in handling; (2) heavy metallic losses; and (3) consequent lack of compositional control in the mix. The process indicated shows that handling difficulties are minimised by encasing the turnings in mild steel cannisters. This is not new, for we have seen it practised at Fords, Alfred Herbert's and the Fulwood Foundry—but in the last case wooden boxes were used, whilst in the two earlier instances use was made of jar-ramming machines for intense consolidation. The second phase, that of high metallic losses, is often to be associated with (*a*) mechanical expulsion by means of the blast blowing the cupola, or (*b*) entering the slag because of heavy surface oxidation, whilst the third phase, that of lack of compositional control, is intimately associated with considerations (*a*) and (*b*). The former is eliminated, *ipso facto*, because of the encasement, whilst the latter is eliminated by the germ of the new process.

When one possesses a canister of turnings weighing, say, forty pounds, it is obviously child's play to reduce the sulphur to reasonable proportions by the addition of soda ash, but, in addition, it is also easy to increase the carbon by the addition of a little coke breeze or anthracite. An increase in the silicon or manganese content can also be readily effected. Taking the process a stage further, alloy additions such as nickel, chromium, titanium or molybdenum could also be added with the assurance that intimate mixture is initially ensured, associated with the advantage that fusion is not likely to take place before the melting zone is reached.

We have not drawn attention to an advertisement from any ulterior motive, but with the certain knowledge of the defects previously experienced—especially in Germany—under stress of abnormally high production. The major defect was that of inverse chill, but others, less obvious, accounted for serious wastage. The utilisation of a canister for this purpose, as when used for the preservation of food, affords an equally important opportunity for the conservation of much good metal, which would otherwise be lost, or would at least contaminate the balance of the charge.

The Value of Practical Experience—II

We saw last week that in proper courses of training for the professions the acquisition of practical experience is provided for through an apprenticeship. The practical training is not intended to make the budding manager a skilled moulder any more than an engineering course makes an executive a skilled turner or fitter; nevertheless, the course has its values. As a people we have a profound distrust of book-learning, and always prefer to see it tempered with practical experience. Apart from teaching the nature of the everyday materials and processes used, it is good that a man should work alongside the men he hopes one day to lead. He learns their outlook and special difficulties, and they in turn learn to respect him. There is wisdom in the plans which invariably arrange for members of the Royal family, for instance, having a spell in one or more of the services. A manager without that practical experience is perpetually under the necessity of deferring to the superior practical knowledge of a man junior to himself. Whether this is realised or not, some such feeling is at the back of the difficulty our correspondent stresses. Whatever his other limitations, a man with direct practical experience of labour, of fixing piece rates, and of moulding and coremaking, will have a strong pull over the laboratory man. The latter can only make good these gaps by long contact with the foundry and close observation. The young chemist who seeks managerial responsibilities would do well to take a job on the floor for a time.

We believe, of course, that the only way to overcome these difficulties is to arrange proper apprenticeships for men who have technical knowledge, such as a university or technical college provides, and to provide technical courses for those who have practical experience. The industry at present has practically no provision, within foundries themselves, for the training of higher executives. It is no use complaining that there are no good men to be had if no steps are taken to repair the deficiency. We know, of course, that many things go to make a foundry executive, and would not sacrifice them for manual skill, but the desire to appoint men of proved practical experience and qualities of leadership has a deep root and there are sound reasons for it.

C

Notes from the Branches

East Anglian Section.—Thirty members of the East Anglian Section and the London Branch last Wednesday visited the works of the Suffolk Iron Foundry (1920), Limited, at Stowmarket, at the invitation of Mr. L. Tibbenham, who with his son welcomed the visitors. One of the main sources of interest was the working of the time control system which formed the subject matter of a Paper read before the East Anglian Section during last session, and which has been published recently in our columns. No less than 150 tons of iron are melted per week, all of which goes to make quite small castings. All moulds are made on machines of various types, served by an overhead sand system. The assembling and paint spraying departments also afforded a good opportunity for studying the procedure adopted there. After inspection of the works, the visitors were entertained to tea by Mr. and Mrs. Tibbenham.

Mr. V. Delport (President of the London Branch) proposed a vote of thanks to both Mr. and Mrs. Tibbenham for the manner in which they had entertained the visitors. The vote was seconded by Col. Portway, the Section Vice-President. Before dispersing, an invitation was issued to the members to stay to play bowls, and many availed themselves of this courtesy.

Scottish Branch.—The invitation which the directors of G. & J. Weir, Limited, extended to the members of the Scottish Branch to visit their Holm Foundry at Cathcart, last Friday, was obviously much appreciated, and about 170 members were conducted through the various departments of the works, including the mechanical, chemical and physical laboratories, non-ferrous and iron foundries, patternshop, machine and erecting departments, by guides who were either officials of the foundry or moulders under the direction of Mr. N. McManus, M.B.E., the general foundry manager, and Mr. Evan Ross, the Branch-President elect. At the conclusion of the visit the party was provided with light refreshments in the works school room.

MR. FRANK HUDSON, the retiring Branch-President, in proposing a vote of thanks to the directors of the firm for having granted permission for the visit, and to Mr. McManus and his staff for the manner in which they had carried out the arrangements, expressed the appreciation of the members for the opportunity of seeing in operation the latest and most modern equipment. He referred to the fact that the number who had taken advantage of the privilege was the largest that had taken part in any visit organised by the Scottish Branch.

MR. N. MCMANUS, in responding, apologised for the absence of the directors owing to previous engagements. He expressed his appreciation of the great interest the party had shown in the works equipment and products and the large number who had accepted the invitation. He asked them specially to thank the guides who had readily volunteered to put in overtime to accompany the visitors round the works.

Buell Combustion Company

A capital reorganisation scheme is proposed by the directors of the Buell Combustion Company, Limited. It is proposed to reduce the capital from £250,000 to £42,140 by writing down each of the 249,432 issued shares from £1 to 3s. 4d., these shares as so reduced to be consolidated into 41,572 shares of £1 each. The capital will then be increased to £250,000 by the creation of 207,860 shares of £1 each, of which 60,000 will be 6 per cent. cumulative convertible preference shares. The directors propose to create a series of £60,000 five-year non-interest bearing registered notes redeemable on maturity at a premium of £30 per cent. The company will establish a sinking fund for the redemption of these notes. The whole of the cumulative convertible preference shares and notes will be offered to members for subscription at par.

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

The "Speedy" Moisture Tester

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—As the representatives of the manufacturers of the "Speedy" moisture tester, referred to in the Paper given by Mr. W. Y. Buchanan, and published recently in your JOURNAL, in which he states that the moisture tester *recommended by the Institute's Sub-Committee* is insufficiently accurate for research work, we wish to state that this is not the opinion of continual users of the apparatus. For sands and similar substances we guarantee the accuracy to 0.1 per cent., and this is not the result only of our own findings, but the experience of our customers.

In respect of Mr. Buchanan's remarks, referring to the zero adjustment on the dial, such an adjustment would complicate an apparatus, and we consider no good purpose would be served, as the only possibility of doing damage to the apparatus is if it is allowed to fall on the floor or be bumped against any hard object, when the gauge must naturally be recalibrated by the makers.—Yours, etc.,

J. H. COOPER
(Managing Director,
Robson Refractories, Limited).

47, Coniscliffe Road, Darlington.
June 2, 1937.

Recruitment Problem

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—Having read "A Recruitment Problem" in the May 27 issue, I have a suggestion to make. "Qualified," being of the "University" type, ought to have money. Failing that, surely some of the many similar men with whom he comes in contact are the fortunate possessors of some capital. There is a good demand for castings at present. Why does he not start a foundry, or buy a foundry business, and demonstrate, with his own capital, the short-sighted policy of those at present running foundries without employing the type referred to by "Qualified."—Yours, etc.,

BRASSFOUNDER.

The Derby Conference Fund

The Foundry Trades' Equipment and Supplies Association has contributed the sum of £57 10s. to the Derby Conference Fund of the Institute of British Foundrymen.

This sum has been subscribed by the following members of the Association:—Atlas Preservative Company, Limited; August's, Limited; Bradley & Foster, Limited; Coleman Foundry Equipment Company, Limited; Constructional Engineering Company, Limited; William Cumming & Company, Limited; Fordath Engineering Company, Limited; Foundry Plant & Machinery, Limited; FOUNDRY TRADE JOURNAL; General Refractories, Limited; Sterling Foundry Specialties, Limited; Universal System of Machine Moulding & Machinery Company, Limited, and Thomas Wilkinson & Company, Limited.

DAVID BROWN & SONS (HUDD.), LIMITED, of Huddersfield, have done a real service to their customers who use "Radicor" worm reducers and "Cone Ring" couplings, by making available two computators, the use of which simplifies selection for specific duties and renders errors impossible. They have been made available to our readers on request.

Random Shots

The Foundrymen's Derby is now in "Full Sail," the "Mid-day Sun" is still doing its stuff, and the new treasurer is apparently satisfied with the form of his "Cash-Book." But more of the Conference next week. Be it sufficient at the moment to wish the new President good luck, for he has a Bigg year in front of him.

* * *

The Paris Conference will come as a sort of Oaks after Derby, and whilst sighing for a "Sweet Content" not generally found in that gay city, one can at least wish the "Exhibitionists" good sport amongst the fillies!

* * *

There are no grounds for the fear that the workmen engaged on the demolition of the Paris Exhibition will clash with those still engaged in erecting it—though there is a story told of a busy man who complained bitterly to the stationmaster at the Gare du Nord that his train, in which he was travelling to visit the Exhibition, arrived half an hour late. The stationmaster blandly smoothed matters out by explaining that the train was far from being half an hour late. It was a month too soon!

* * *

There is an interesting note in the house-organ of Marsman's of the Philippines that two additions have been made to their staff, Mr. Hell and Mr. Furnas, and, incidentally, that Mr. Furnas has had many years of smelting experience. Mr. Hell is a mining engineer, and already an expert on that place below the earth!

* * *

And, talking of appropriate names, Sir Ernest and Mr. P. W. Petter having retired from active participation in business, must have every confidence that the affairs of the firm will continue to keep Good and not run down Hill under the direction of a newly appointed board.

* * *

Sir Patrick and Lady Hannon gave a very successful garden party at Magna Charta Island last Saturday, in honour of the Prime Minister of Australia. They were favoured with a perfect English summer day, which was especially gratifying considering the number of overseas visitors present. There will be a few Australians, at least, who, when asked if they spent a certain summer in England, will not be able to answer "No, I was in Paris that day!" Mr. Lyons, it is said, has a very large family—something nearing a baker's dozen. Mr. Frank Russell may have a good record for England, but he no longer holds an Empire record.

* * *

Sir Patrick Hannon, already well known to foundrymen, will particularly be remembered by the London Branch as their guest of honour at their dinner of a year ago, and will stand out in the minds of everyone who has heard him as a brilliant after-dinner speaker.

* * *

Inspect our flats before deciding to live elsewhere—reads an advertisement in a daily paper!

* * *

Saying of the week:—Mr. Cecil Roberts: "There is a feeling abroad nowadays that authors are interesting objects to look at. They are not." So, fellow contributors, now you know!

"MARKSMAN."

German Ironfounders' Association

PAPERS PRESENTED TO THE ANNUAL MEETING

At the 25th Annual General Meeting of the German Foundry Technical Association, which was held in Berlin on May 8, a number of Papers were presented—some of them being of interest as indicating how imported raw materials may be replaced or eliminated—and we append a number of abstracts of the more important ones.

Design of Elektron Metal Castings from the Standpoint of Material

By Dipl.-Ing. P. SPITALER.

Following introductory remarks dealing with the technology of the casting of light metal alloys, special consideration being paid to the fundamental differences from heavy metals, and to the technical and economic possibilities of applying the three particular methods of casting (sand casting, chill casting and die casting), the design of Elektron castings was discussed fully from the standpoint of foundry practice and material. The "design from the standpoint of foundry practice" includes all the principles relating to the easy and cheap production of satisfactory castings in the foundry. The "design from the standpoint of material" is understood to comprise the principles aiming at the reliability of the castings in service. With reference to a large number of practical examples, the most important points governing the choice of the alloy in each case and the particular method of casting, as well as the configuration from the standpoint of the material were discussed. Very often the principles which have long been known for heavy metals are applied to Elektron castings, but in many cases different measures, applicable only to Elektron castings, are to be recommended. It was suggested that in addition to following the principles given, a close co-operation between designer and foundryman is desirable.

Casting Properties of Non-Ferrous Alloys

By F. HÖHNE.

The author discussed a large number of experiments and considerations intended to provide foundry practice with a fuller knowledge of the casting properties of non-ferrous alloys. The melting and superheating temperature of various alloys were given and it was deduced from Dulong and Petit's law that the superheating temperature which is essential for the casting operation diminishes with the atomic or molecular weight.

The life of various non-ferrous alloys has been investigated. The results show that this depends not only upon the superheating temperature, the fall and the freezing range, but that the degree of purity of the alloy and the oxide film formed during the casting are also of critical importance.

Furthermore, the tendency of various alloys to exhibit segregation was discussed. Inverse segregation occurring in the casting of alloys is very troublesome but may be minimised by suitable flame control during the melting operation and by covering the bath. Inverse segregation depends upon the solubility of gases in the molten metal, the magnitude of the freezing range and the number of alloying components.

The solubility of gases in various metals was discussed and various indications were given as to the treatment of alloys containing gases.

With reference to experiments, it was possible to show that the tendency to pipe-formation in alloys according to German Industrial Standard 1705 depends mainly upon the degree of purity.

Foundry Fluxes, Their Application and Action in the Casting of Aluminium

By DR. ING R. IRMANN.

In the melting of aluminium and aluminium alloys, the points of view which apply are to some extent different from those obtaining in the case of heavy metals. In the molten state, aluminium absorbs gases, as do also the heavy metals, and these gases are only partly expelled again when the aluminuim solidifies. Since aluminium is closely related to oxygen, this metal, which even oxidises in the solid state at room temperature, will oxidise very readily when melted, but there is no possibility, such as exists in the case of the heavy metals, of reducing this oxide. The purpose of fluxes, the necessity of which is no longer disputed nowadays, is to afford protection against further oxidation and absorption of gases and to purify the molten metal from the gas and oxide which it usually contains. The action of fluxes may therefore be manifold, and in employing them, it will be necessary on principle to make a distinction between whether it is a matter of preventing further oxidation of the charge during the melting operation and preventing loss of metal during the removal of the dross, or whether the molten metal is to be purified before casting, *i.e.* is to be freed from gases and oxides. The determination of the loss of metal during melting, employing various fluxes, is only possible by means of tedious experiments on an industrial scale, an essential condition being that the charge should always be the same in respect of the nature of the surface and the size of the pieces, and that the melting conditions should not vary. It is of course very difficult to observe such uniform conditions, and it is natural if sometimes no very clear notion can be obtained regarding the action of a flux. The action of a flux added for degasification or for de-oxidation is on the contrary much easier to ascertain. It is thus possible to show how the life of an alloy may be very substantially increased by the use of a flux, a factor which is of exceptional importance in the case of chill castings. The difficulties occurring in the melting of hardenable, usually low-magnesium aluminium alloys, and caused by the loss of magnesium, may be removed by using suitable fluxes. In the same way, the production of aluminium alloys having a high magnesium content has only become possible after the introduction of special fluxes. In some cases, also, the action of fluxes, especially in the melting of scrap, may be ascertained from the mechanical strength. A special matter is the handling and storage of fluxes, all of which are strongly hygroscopic, and also their application in practice.

Chill Casting of Aluminium Alloys

By Dr.-Ing. A. VATH.

In view of the greatly increased application of aluminium and its alloys, chill casting is acquiring an enhanced importance as an economically satisfactory method of production. The aluminium alloys which are at the present time most important in regard to chill casting were subdivided into groups according to their applications and were briefly discussed with reference to the values attainable for the strength of the castings, the properties from the point of view of foundry practice and the fields of application. Reference was made to the most important hardening alloys, including the alloy TSS 3, so successfully introduced in 1936, the high strength of which enables chill casting to be applied, also to the production of highly stressed constructional elements, previously reserved exclusively to heavy metal welded constructions or light metal forged contructions. The correct arrangement of the chill, satisfactory melting of the alloy and observance of the chill temperature and casting temperature are of critical importance for successful production.

After indicating the principles which govern the arrangement of chills, the shrinkage of alloys was discussed for chills with steel cores and chills with sand cores. The degrees of accuracy attainable with steel and sand core chills were likewise enumerated. Reference was made to the production of sand cores which cannot always be avoided. In the case of chill casting also, it is desirable to avoid designs of castings which are unfavourable from the standpoint of foundry practice. Unequal wall thicknesses give rise to hot cracking, particularly in the case of magnesium-containing and high copper alloys. An account was given of the measures for combating pipe-formation at places of very unequal wall thickness (lugs). Nowadays, the tendency is to make chilled castings as thin-walled as possible, and for large thin-walled castings, for example, covers, indirect pouring is to be recommended. In the case of small, thin-walled parts, good venting of the chill is essential for success, leading, in the case of ribbed members to their complete laminar structure. In order to improve venting still further for very difficult ribbed castings, suction chills have been adopted. In special cases, castings are produced by means of the combination mould, which being half chill and half sand mould, represents a connecting link between chill and sand casting. The difficulties and structure of such combined forms were discussed.

Supervision and Research in Steel and Malleable Iron Foundries

By Dr.-Ing. K. ROESCH.

The requirements which foundry products are expected to satisfy are becoming increasingly more severe, not only from the standpoint of moulding technique but also from that of material. The motor-car industry, high-pressure technique, chemical industry, armament manufacture and other branches of engineering set the foundryman the problem of devising and casting new kinds of steel. Low-price quantity production necessitates the reduction of waste to the lowest possible minimum, rendering essential a very detailed supervision during the production of the casting. For such supervision to be as effective as possible, close investigation of the metallurgical processes and of the material itself is indispensable in order to eliminate quickly and surely the defects found in the course of the supervision. As example of such supervision, the production of a malleable iron fitting is discussed with the aid of a genealogical diagram. The type of casting concerned is one which, in respect of its composition, heat-treatment and mechanical properties varies within very narrow limits. Since this material is often used in series production, there must be a very close and constant supervision of each operation to prevent slight discrepancies resulting in excessive waste. Supervision should therefore be such that any defect can be discovered and removed as quickly as possible. Knowledge acquired by research increases the reliability of the supervision. The numerous supervision stations through which a fitting passes from the raw material to high-grade foundry product are as follows:—

Examination of the raw materials. Sampling and measuring the temperature of the molten material. Examination of moulding sands. Supervision of the annealing furnaces. Continuous testing of the strength of the material.

The numerous results of this uniform material enable statistical research methods to be applied, so that valuable deductions may be drawn from comparisons made over long periods of time and

from the observations of fluctuations. Whereas, in the case of malleable iron, a very uniform material is being dealt with, the properties of the steel casting vary very widely both in regard to composition, from the unalloyed material to the high-grade special steel casting, and also in regard to the heat-treatment. There is here a very wide field for research. From the point of view of supervision, the production of steel castings differs very little from that of malleable iron castings. The testing of the material requires, however, special devices which differ greatly according to the nature of the use of the material. In this case also, all results should be recorded and utilised for practice. Each kind of steel casting should have a record sheet allocated to it containing all the properties, and one of the principal problems of research is to fill in this sheet completely. All the results should be made useful to the practical man in the form of brief reports and discussions. Suggestions made on both sides will result in progress, a deeper knowledge of the material and the prevention of mistakes. A number of examples are briefly described to show the evaluation of the results. Supervision also extends to the pertinent literature. The research department should cover all domestic and foreign literature to keep the busy practical man in touch with it by means of short abstracts, translations or books and to keep him always posted with the latest position in his own particular field.

The research and supervision department has thus the following functions to perform:—

(1) Supervision of the quality and attention to objections.

(2) Research to deepen the knowledge of the material and to improve and develop new types of casting.

(3) Advising the works and sales department.

(4) Scanning and procuring technical literature.

(5) Attending to metallurgical patents.

(6) Connection with scientific associations and technical authorities.

The functions should be subdivided according to the size of the works. A brief description is given of the organisation. The closest and confident co-operation between the works and the research department is necessary for the success of the undertaking. Experiments should always be made in the closest co-operation with the works. Research is necessary for achieving progress. Supervision is necessary for preventing loss.

The Transverse Strength of Steel and Malleable Iron Castings

By Dr. F. ROLL.

Testing the transverse strength of cast iron formerly played a considerable part, and still does so in conjunction with the investigation of the tensile strength, but in the case of malleable iron and steel castings, however, there has scarcely been any inquiry as to the transverse strength. In the literature also, only a few isolated figures are to be found for the transverse strength. Modern research, for instance in the case of steel, has, however, paid more attention to this property, and since consumers are also demanding transverse strength figures in the case of these two materials, investigations have been made after the manner of former investigations on cast iron directed by Rudeloff. Under certain conditions, the transverse strengths, and still better the yield points of both materials, may be utilised in practice. The investigation has been carried out on blackheart and whiteheart malleable iron and on acid Siemens-Martin steel of different carbon contents cast into green-sand moulds. The figures for the transverse strength or yield point may be well compared under certain preliminary conditions if they are put proportional to the quotients $\frac{\Delta s}{\phi}$. Definite curves are obtained, although it is true that the transverse strength figures for round bars are more scattered in the case of whiteheart malleable iron than in the case of blackheart malleable iron. The figures for the latter for square and round bars lie very closely on a curve. According to the distance between the supports, the transverse strength of whiteheart malleable iron lies between 70 and 120 kg. per sq. mm. (for a tensile strength of from 50 to 62 kg. per sq. mm. for the 12 to 30 mm. bar). For blackheart malleable iron, the figures are lower in agreement with the purely ferritic structure and vary between 65 and 95 kg. per sq. mm. according to the distance between the supports. The figures for the yield point lie between 55 and 75 per cent. of the ultimate strength, *i.e.*, higher than the corresponding figures for the tensile test. Regarded from the testing point of view, the yield point for cast steel is more important than for malleable iron, since this material has a greater surface sensitivity. For steel 38.81 (tensile strength 39.5 kg. per sq. mm.; elongation 27.0 per cent.) the yield point lies between 41 and 61 kg. per sq. mm., according to the quotients $\frac{\Delta s}{\phi}$. For steel 45.81 (tensile strength 48.5 kg. per sq. mm.; elongation 20.1 per cent.) the yield point lies between 35 and 59 kg. per sq. mm., and for steel 52.81 (tensile strength 55.6 kg. per sq. mm.; elongation 16.8 per cent.) it fluctuates within the limits of 58 and 116 kg. per sq. mm.

Economising in Metal by Composite Casting

By Dr.-Ing. E. KNIPP.

Methods of producing composite castings, that is to say wherein a high-grade material for a special purpose but expensive and a material which is less suitable but cheaper are cast one upon the other, afford the foundryman endless possibilities in economising in foreign raw materials without reducing the suitability of the casting for the intended purpose.

In this way, a method has been developed whereby bearing brasses, particularly those for railway work, which formerly were cast entirely of red brass, can now be made of composite castings—cast steel and red brass—with perfect union of the two cast metals at their surfaces of contact, thus effecting a saving of up to 75 per cent. of red brass. This process, originally intended only for bearing brasses, has also been successfully applied, in a modified form, to the production of other metal parts, such as valve spindles and plugs of cocks. The composite casting of spindles, for instance, which hitherto have been made of drawn brass, enables a saving of about 50 per cent. of the brass to be effected. The union of the two metals forming the composite casting is so perfect that even when the casting is subjected to the greatest deformation or the connecting layer is removed on a lathe, the two metals cohere together as if they consisted of a single material. Furthermore, stuffing-box glands, caps, rings and finally entire housings for cocks have been successfully made by the composite casting method, equally good results having been obtained with steel, grey iron or malleable iron as one metal and red brass or brass as the other metal.

Investigation of Moulding Sand Mixtures

By Prof. Dr.-Ing. H. UHLITZSCH.

In his introductory remarks, the lecturer pointed out that a considerable proportion of the waste of a foundry may be ascribed to unsuitable or wrongly treated moulding sand. He then proceeded to discuss the mineralogical composition of moulding sands and their general classification according to the size of grain and the clay content. After reviewing the usual properties, such as permeability, strength and refractoriness, the influence exerted on these properties by the characteristic components of moulding sands was discussed in detail. To illustrate these remarks, lantern slides of the different grain classes of an elutriated moulding sand were shown and the corresponding mineral composition was given in each case. The comments regarding refractoriness which then followed were also illustrated by lantern slides of samples of sand, showing the typical changes undergone by a moulding sand treated at temperatures from 800 to 1,400 deg. C. In this connection, the lecturer referred to recent investigations dealing with the changes in the properties of moulding sand with rising temperature.

Two adverse factors are, however, involved: (1) the expansion of the quartz component at temperatures of up to 870 deg. C., and (2) the shrinkage in the temperature range of 800 to 1,100 deg. C., both of which may lead to serious defects in a sand mould, particularly since numerically, the maximum expansion lies between 0.9 and 2.1 per cent. and the maximum shrinkage between 0 and 0.5 per cent. variation in length. Reduction of these figures is possible by increasing the size of grain, reducing the proportion of fine material, using a very loose mould, increasing the permeability, reducing the clay content, reducing the moisture content, addition of combustible materials, coating the mould with thermal insulators.

From this it follows that the investigation for permeability to gases represents a simple means of testing the stability of a moulding sand at high temperatures. With reference to these comments, the lecturer then discussed the causes of the most well-known mould defects, such as cracks, friability, boiling of the iron, uneven surface and erosion, and deduced the conclusion that for deciding the serviceability of a moulding sand, the investigation should cover the measurement of permeability, shearing strength, compression strength and refractoriness, while in practical operation it is necessary to control the moisture and the addition of coal dust. From these points of view, the lecturer has carried out investigations on moulding sand in practical foundry operation, directing his attention more particularly to the possibility of effecting an improvement in moulding sand by mixing (blending) different sands. With the aid of diagrams two examples of these experimental series were discussed, it being possible to read the optimum blending proportions in a very simple manner. Of importance is the fact that by blending two moulding sands, neither the permeability nor the strength fell below that of the moulding sand of lower grade. An apparent exception was explained as being due to the occurrence of lumps consisting of the finest fraction. The application of the results obtained in the laboratory to practical operation has been altogether satisfactory. A permeability which was too low for large castings was found to be improved by the use of coal-dust sifted to a suitable particle size.

Synthetic Moulding Sand, Its Preparation and Properties

By H. REININGER.

Synthetic moulding sands differ from natural sands as obtained from the quarry by the nature of their structure. Natural moulding sands are obtained already as a mixture of clay and silica, whereas the characteristic feature of synthetic sands is that their constituents are combined in certain proportions recognised as being particularly expedient, and are rendered homogeneous by intensive mixing. A constituent of synthetic sand is silica which in the form of river or sea sand has no cohesive strength, so that binders

have to be added. Such binders are clay, organic preparations in the form, for example, of starch flour products and sulphite liquor powders, as well as the inorganic binder "Geko" which has highly swelling properties. The appreciation of a binder for synthetic sands depends upon its efficiency per unit weight of the amount added, that is to say, a binder is more valuable, the smaller the amount which has to be added in order to produce certain properties in the sand. In this respect, ordinary clays are not so suitable as binders, since they are only effective in additions of 10 to 40 per cent. Organic binders are effective at a proportion of even 4 per cent.

The most effective binder is "Geko" which, notwithstanding the low weight of the quantity to be added—about 1 per cent.—in consequence of its power of swelling in water, a property not even approximately attained by any other binder, supplies the moulding sand with such a large volume of binding material for causing the sand grains to adhere together that greater strengths are attainable than with other binders. The important advantages of such sand mixtures from the practical standpoint, as compared with blended natural sands is the possibility of systematically cultivating those properties which are recognised to be particularly valuable and above all keeping them constant with a very narrow margin of divergences. Appropriate binders are also suitable for the regeneration of spent sands which, in consequence of the treatment during casting, have been burnt in the moulds to such an extent that after being prepared afresh, they are not even approximately capable of chemically binding as much water as before being used for the first time. The strength thus lost may, however, be restored by the addition of binders, similarly as in the case of the above-mentioned synthetic sands. Spent sands regenerated in this way are also synthetic sands, since they are produced by blending after systematic proportioning of the various constituents.

In the treatment of spent sand, a particularly important problem is that of the removal of silt, since an excessively high silt content renders the spent sand unserviceable. Apart from mechanical means, air and water as silt-removing agents, some inorganic binders also possess a certain importance as such silt-removing agents since they are capable either of partly suspending the silt or of causing it to adhere together in the form of small agglomerations. Pictures of a particularly efficient sand preparing plant showed the discharging station for the spent sand, the crushing of core and mould fragments in a mill, the conveying of the spent sand to a bunker, the charging of a mixer tub by the bunker, the addition of binder, the mixing of the mixer tub "charge" in a mixing trough, followed by the throwing of the sand by a high speed thrower on to a rubber conveyor belt and the charging of individual bunkers by the conveyor. Thus, with correctly prepared spent sand—synthetic sand—it is not only possible to obtain definite important properties from the point of view of foundry practice better than with mixtures of natural sand, but over and above this, the material is also utilised better and more completely.

Crankshafts of Grey Iron

By Dr.-Ing. Th. KLINGENSTEIN.

Recent technical literature contains many accounts of cast crankshafts, but so far no comprehensive review has been made, particularly regarding the intrinsic reasons for the possibility of using cast iron for the production of crankshafts. It is, of course, well known that, besides its high damping properties, the suitability of cast iron resides in the possibility of casting it into any particular shape and thus, by reason of its high resistance to varying stresses and low sensitivity to impact, of attaining a high stability of shape. The values obtainable in this respect are often not attained with the other materials employed. The favourable anti-friction properties of cast iron in all the bearing materials which come into consideration are also particularly valuable. These properties are only possessed by material having a pronounced character of cast iron. From the economic standpoint, cheap production is also an essential, a requirement which is satisfied adequately only by a material which can be employed without after- or heat-treatment.

These points of view were discussed in the lecture and the prices of cast crankshafts and steel crankshafts were compared. The practical results obtained are very satisfactory and allow one to predict a very extensive increase in the use of cast crankshafts.

There can be no doubt that this development is only possible, however, by employing a material which, as previously stated, possesses a pronounced character of cast iron and in addition has the advantage of being easy to cast.

Tin-Free Chaplets and Core Nails

By P. TOBIAS.

The development of the internal combustion engine has increased the difficulties in the production of the castings. Differences of 4 to 30 mm. in the wall-thicknesses of a cylinder block are by no means rare. It very often happens that castings are composed of 40 or 50 cores, and it is not always possible to support these cores by means of core prints. Chaplets are inserted for keeping the cores in the correct position and for securing them against fracture. In the fabrication of wheels, steel spokes are cast in. Cooling spirals and nails are used to prevent pipe-formation, and in other constructional parts, journals, shafts, blocks, etc., may also be cast in. These foreign bodies cannot be used in the "as supplied" condition on account of the oxide film and the resulting blow-hole formation. A thin coating of tin is the simplest means of affording protection against oxidation, but since Germans are obliged to refrain from using tin, other methods must be adopted.

The investigations carried out by the Committee of the Association of German Foundrymen have shed some light on this question. With the parts in the "as supplied" condition and without additional after-treatment, intense blow-hole formation occurred in the entire zone during casting, whereas after the parts had been pickled with hydrochloric acid and washed with petrol or ammonium chloride solution, it was possible to cast them in satisfactorily without blow-holes. Very often, mill scale cannot be removed by sand-blasting and it has also been found that polished places are immediately coated with a fresh film of oxide giving rise to unsound castings.

Considerable success has been obtained by coating the parts with a cadmium, cadmium-copper or a copper layer. Coating was carried out electrolytically after pickling and de-scaling. If the method is carried out carefully, treatment with cadmium is as good as tinning and in most cases is even preferable.

The Melting of Steel and Cast Iron in the Light of Present Metallurgical Knowledge

By Dr.-Ing. P. BARDENHEUER.

The ever increasing requirements which engineering, in its rapid development, expects of metallic materials render it compulsory to increase the quality and to improve the methods of production. The research work carried out up to the present time has made good progress particularly in the field of steel production, but the fresh knowledge thus acquired may also be usefully applied to the melting of cast iron. The centre of the chemical metallurgical reactions in the production of steel is the reaction of the carbon with oxygen in the steel bath. Provided the temperature is sufficiently high, the carbon keeps the oxygen content of the steel very low. Only when the carbon content drops considerably or when for other reasons the carbon is no longer able to react vigorously with the oxygen, the content of the latter in the steel rises rapidly, the rise being increased as the percentage of ferrous oxide found in the slag is raised. In this case, the supply of oxygen to the steel bath may be diminished by a higher manganese content. The particular advantages of the reduction of manganese from the slag were discussed. Melting under reducing conditions is particularly advantageous in the acid furnace. The silicon reduction which governs the high quality of crucible steel may also be effected with equal success in other furnaces, even in the large open-hearth furnace. An important advantage of this method of melting is that steel melted under reducing conditions does not require subsequent de-oxidation, thus obviating the risk of spoiling the steel by gases and oxides introduced into the bath with the de-oxidising materials.

The devasting effect of hydrogen which remains in the steel after melting and may collect at the grain boundaries under high pressures was dealt with in detail. It is shown that the metallurgy of cast iron does not fundamentally differ from that of steel. The metallurgical processes in the melting of cast iron are considered in the light of modern knowledge, primarily with the object of producing sound castings. Unsound castings, resulting either from a belated reaction of the carbon with the oxides of the cast iron in the mould or from the liberation of dissolved gases during the freezing of the metal, must be carefully avoided, and steps for preventing these defects are discussed. Finally, the lecturer dealt with the desulphurising of cast iron which fundamentally is effected from the same points of view as the desulphurising of steel. The remarks showed that metallurgical research which has been remarkably successful in regard to improving methods of steel production and raising the quality of steel may also be correspondingly helpful and useful in iron and steel foundry practice.

The Present Position of the Superheating of Molten Cast Iron

By Prof. Dr.-Ing. habil. E. PIWOWARSKY.

Prof. E. Piwowarsky spoke on the present position of the superheating of molten cast iron. Even as recently as the commencement of 1925, no methods were known for bringing about the separation of the graphite in grey cast iron, which is well known to be of decisive importance for all the properties of this material, in the form of a fine eutectic temper carbon, not after an annealing treatment in the solid state of aggregation, as in the case of malleable iron, but during the freezing of the metal. This problem had already engaged the attention of wide industrial circles and technical research institutes, and there is no doubt that useful principles tending to the postulation of the problem had already been discovered, but before the publication of the results of these investigations, which had been instituted in several places, Piwowarsky in two Papers published in 1925 developed the principles of the connections he had discovered between the superheating of molten cast iron in abnormally high superheating regions, and the properties of cast iron, particularly its mechanical properties, in their relationship with the graphite formation as systematically influenced by the preceding superheating. These Papers formed the starting point of numerous investigations in Germany and elsewhere, and their effects have contributed in no small measure to the extraordinarily rapid development in the quality of cast iron within

the last ten years. Together with the very advanced research work in Germany on methods of increasing the certainty of the results in the melting of cast iron, the reliable melting of high proportions of steel scrap on a practical scale in the cupola and the systematic alloying of cast iron with special elements, they contributed in the development of the qualities of cast iron as a material, so that its specific importance among the numerous metallic materials is assured for many years to come, notwithstanding the competition of light alloys, the competition of welding technique and the competition of non-metallic types of materials.

In the scope of his work, however, Piwowarsky had already found that the discoveries made regarding the effects of superheating are not limited to grey cast iron alone, but the knowledge thus acquired may be usefully applied to the effect of superheating on the properties of high-grade cast iron, malleable iron and tin and aluminium bronzes, and also even the properties of commercial steel alloys.

The work done by Piwowarsky on superheating was also of importance in connection with an absolutely new line of investigation, namely, that of ascertaining quite generally the relationship between the structure and properties of commercial metals and useful alloys and the degree of superheating before casting, and hence the condition and structure of molten solutions. Previously it had been believed that the fluid state of metallic substances was characterised by a complete collapse of the crystal lattice and a complete breakdown of the molecular groupings, but in consequence of Piwowarsky's conjectures, which tended to show that molecular groupings of importance in connection with the subsequent crystallisation, are capable of persisting in the liquid state, even up to high melting temperatures, research work and investigations were extended and the results, while confirming Piwowarsky's conjectures, at the same time opened up an entirely new viewpoint regarding the forms of state of molten metallic solutions. In this connection, the systematic work of the Kaiser-Wilhelm Institute for Iron Research in Düsseldorf and also various investigations carried out by other German technical and research institutes have assisted in understanding this problem.

It is understandable that Piwowarsky's work on the research problem of superheating brought numerous opponents into the field, but after the lapse of twelve years, it may rightly be stated to-day that superheating, when carried out systematically in abnormally high superheating ranges not previously employed, undoubtedly belongs to those metallurgical operations, the object of which is to develop further the quality of useful commercial alloys.

Among the many opinions of Piwowarsky's work, perhaps the most characteristic are the following comments which appeared in "The Metallurgist" of January 29, 1936:

"Prof. Piwowarsky's work may prove to have opened up a new avenue in the treatment of cast iron and possibly of other complex alloys. And it can be said that a new line of research has been suggested by these experiments, but that both the fundamental facts and still more the far-reaching hypothesis advanced to account for them require experimental investigation. All three Papers, however, are of special interest as an indication of the spirit in which German metallurgists are attacking the complex problems of cast iron. The makers and users of cast iron in this country cannot afford to let our investigators lag behind in such an attack."

Correction.—Two misprints occurred in Mr. A. Burgess' article on "The Importance of Models" in our last week's issue. The sulphur content should have been 0.02, and not 0.2 per cent.—a rather low percentage. The second one is the weight of the petrol "lightweight" engine; this should have been 3 lbs. 12 ozs.

International Foundry Congress in Paris

LIST OF PAPERS AND WORKS VISITS

The International Foundry Congress which is to be held in Paris from June 17 to 24 is being organised by the French Foundry Technical Association. The following is a list of the Papers which are to be presented at the technical sessions, and the works which are to be visited. A general outline of the Congress programme was printed in the May 27 issue of the Journal.

Official Papers

"Founding of Malleable Cast Iron—Its Past and Future," by H. H. Shepherd. (*British Exchange Paper.*)

"Cast Irons for Industrial Vehicles," by P. Eddy. (*American Exchange Paper.*)

"Segregation Phenomena in Leaded Bronzes," by Dr. W. Claus. (*German Exchange Paper.*)

"Grain Size in Foundry Practice," by M. Gevers. (*Belgian Exchange Paper.*)

"Aluminium Alloys in Spain," by A. Lafont. (*Spanish Exchange Paper.*)

"Contribution to the Standardisation of Bonding Material and Methods for Determining the Percentage thereof in Moulding Sands," by W. Gurycki. (*Polish Exchange Paper.*)

"Observations on the Addition of Silicon and Tin to Grey Irons," by N. Chvorinor and E. Valenta. (*Czecho-Slovakian Exchange Paper.*)

"Influence of Dimensions, Shape and Casting Conditions of Foundry Test-bars for Mechanical Tests on the Mechanical Characteristics of Foundry Products, especially Normal and Special Steels," by P. Chevenard.

"Plan for Classifying Defects in Castings. Introduction—Foundry Defects Proper," by A. Portevin.

"Moulding Defects," by A. Debar.

"New Outlets for Iron Castings," by P. Muguet.

"New Outlets for Steel Castings," by R. Lemoine.

Papers Communicated by Individuals

"Rationalising the Organisation of the State Railway Foundries at Sotteville," by M. Blanchot.

"Hardening of Martensitic Molybdenum-Vanadium and Nickel-Molybdenum-Vanadium Cast Irons," by J. Challansonnet.

"Influence of Vanadium on the Nitration of Cast Irons," by J. Challansonnet.

"Properties of Special Cast Irons at Elevated Temperatures," by J. Challansonnet.

"Example of the Application of the Apparent-Density Tests in a Foundry making Water-tight Castings," by C. Dennery.

"Foundry Costs," by A. Dormoy.

"Ni-Resist Cast Iron in Great Britain," by Dr. A. B. Everest.

"Rational Localisation of the Use of Materials with regard to their Applications," by R. de Fleury.

"Considerations on the Shape to be given to Iron Castings to develop Maximum Mechanical Properties," by F. Girardet.

"Suggested Applications of Autogenous Welding in the Foundry," by R. Granjon and H. Gerbeaux.

"Foundry Delivery Times," by F. Hénon.

"Self-fluxing Coke for Cupolas," by G. Hénon.

"Influence of Conditions of Solidification on Aluminium Castings," by R. Irmann.

"Safety-First Measures in Czecho-Slovakian Foundries," by E. Kracmar.

"Beryllium Coppers," by J. Laissus and L. Persoz.

"Studies on the Graphitisation of a Pure White Iron," by A. Lissner and O. Kahl.

"Production of Refined Irons for High-Quality Castings," by G. T. Lunt.

"Relationship between the Hardness and Other Qualities of Cast Iron," by G. Meyersberg.

"Heat-Treatment of Large Nickel-Chromium Steel Castings," by J. Obrebski.

"New Method of Moulding and Sand Preparing," by M. Olivo.

"Study of Corrosion Effects on Cast Iron and Steel Tubes," by L. Oslansky.

"Feeding of Castings in Aluminium Foundries," by R. Perret.

"Relation between the Properties of Moulding Sands," by Fr. Pisek and B. Holman.

"Production of Cast-Iron Spoked Pulley Wheels," by F. Simorre.

"Foundry Applications of the Pneumatic Micrometer," by L. Wattebot and A. Brizon.

"Influence of Chromium in Special Low-Alloy Cast Irons," by C. O. Burgess.

"Contribution to the Study of Superhardened Nickel-Manganese Irons," by G. Delbart and E. Lecœuvre.

"Founding of Aluminium and Other Metals," by E. Pizzoglio.

"Young's Modulus and Coulomb's Modulus of Grey Cast Irons," by — Jarès and — Jenicek.

"Study relating to Aluminium Alloys," by Messrs. Alais, Froges and Camargue.

"Temperature Control in Bronze and Aluminium Foundries," by R. Laprand.

Works Visits

Visits to the following works in the environments of Paris during the Congress are being arranged:—

Modern Automobile Foundries at Bondy. (Cast iron. Quantity-production by mechanical moulding.)

Crane Company's Works at La Courneuve. (Industrial and sanitary brassfoundry-work; cast iron; malleable; bronze.)

Aciéries Thome-Cromback at Rueil. (Malleable.)

Company for the Production of Meters and Materials for Gas Works at Montrouge. (Bronze; pressure die-casting.)

Gnome and Rhone Works at Gennevilliers. (Aluminium and Electron; aluminium-alloy forgings.)

Ateliers Rudier at Malakoff. (Bronze art castings.)

In addition it is hoped to obtain permission to visit the works of the Renault Company at Billancourt.

Publication Received

The Architectural Review. Special Issue dealing with metals. June, 1937. London: The Architectural Press, Limited. Price 2s. 6d.

This issue is exceptionally interesting to foundry owners, as it discloses the existence of a receptive mental attitude by the present-day architect, and the information he will receive from this special issue should be distinctly helpful in appraising the relative values of metals for use in his profession. Unfortunately scant justice is done to cast iron. We are told that it is brittle, hard and liable to distortion, whilst on the credit side are good rust-resisting properties coupled with a real *penchant* for taking sprayed-on paint as the surface is porous. We would assure architects that whilst a cast iron can be of the nature described above, it is in reality a range of alloys, the properties of which can be varied within very wide limits, and are of more use to the architect than would seem the case from a perusal of this issue. Brass and bronze castings are criticised on the score of colour, yet the patina acquired by the latter has been eulogised by generations of artists. However, if these alloys are *demodé*, the foundry industry has ample resources for meeting the architect's requirements. Should he desire to be really modern, the foundry and the sheet metal worker between them can give him flat-surfaced glass-covered material in almost any colour—an activity which might usefully have been included. The illustrating and lay-out are in every way worthy of the great profession for which the paper caters.

Foundry Problems

DISCUSSION AT BRADFORD

When members of the West Yorkshire Branch of the Institute of British Foundrymen held their last technical meeting of the session which has just closed, at Bradford Technical College, a number of problems which members had hitherto been unable to solve were submitted for discussion. In the absence of the Branch-President (Mr. Joseph Hepworth, M.P.), on Parliamentary duties, Mr. H. Forrest (Vice-President) occupied the chair.

Attention during the evening was given chiefly to three problems submitted by Mr. E. Illingworth, Mr. S. Carter and Mr. J. Copeman.

Blow-holes in Gas-Melted Alloys

MR. ILLINGWORTH asked which was the best way to eliminate gas-holes in ferrous and non-ferrous metals melted in crucibles fired by town's gas. Mr. Illingworth detailed the working of the furnaces concerned and said the trouble had not occurred when using the former coke-fired furnaces. The trouble even now, he said, did not show itself until the castings were complete and were being machined. Then small pin-holes or gas-holes appeared on the inside of the metal during machining.

MR. S. W. WISE asked what proportion of scrap was used in the mixture, and MR. ILLINGWORTH replied that he was concerned with virgin metals. The trouble was especially seen in phosphor bronze, when 10 per cent. phosphor tin was added immediately the metal was drawn from the furnace.

In reply to the CHAIRMAN, who asked what was the charge melted in the crucible, Mr. Illingworth said they were 150-lb. crucibles, using 100 lbs. of virgin metal and 50 lbs. of gates, etc., from previous casts. The fact that this trouble did not occur materially before changing from coke-firing to town's gas suggested that it might be due to some form of vapour associated with gas.

MR. F. K. NEATH suggested that a reduction in the addition of phosphor tin would overcome the difficulty. It was, of course, well known that crucibles were very porous, and aluminium founders preferred coke-fired furnaces for that reason.

The CHAIRMAN recalled that some years ago he had experienced somewhat similar trouble with yellow brass, but when the alloy had been melted in the old coke-fired pit furnaces there was none of this trouble, and it only occurred when gas-fired furnaces were installed. He believed that the difficulty was overcome by using an oxidising flame instead of the very rich gas flame.

MR. NEATH asked whether Mr. Illingworth had considered the possibility of dealing with the trouble by putting in a surface combustion fire.

The CHAIRMAN said, in melting aluminium, it was a well-known factor that the first pot was liable to be very porous. Glazing the outside of the pot with silicate of soda or something similar might avoid the porous condition of the pot and help to meet the trouble.

MR. S. W. WISE said that some years ago he was casting phosphor-bronze sticks in iron chills, and they occasionally experienced gas-holes. Phosphor tin was used and, on analysing it, very little phosphorus was found in it. The trouble was overcome by adding more phosphorus in an amorphous form.

MR. ILLINGWORTH asked what amount of phosphorus should be added to a 9 to 10 per cent. phosphor bronze.

The CHAIRMAN, assuming Mr. Illingworth was using about 5 per cent. phosphor tin, recalled an occasion in his own experience on which the addition of a little more coal-dust cured the trouble, but that, of course, was adding still more complications, and if Mr. Illingworth was satisfied it was metal trouble, he would hardly recommend that.

MR. A. W. WALKER suggested that the trouble might be due to cooling the water vapour in the town's gas.

The CHAIRMAN said that it was a possibility, and would be almost insuperable if that were so.

MR. G. NIELD asked whether Mr. Illingworth was sure his mould was well vented. Once a mould began to boil through insufficient venting, there was likely to be trouble.

MR. ILLINGWORTH said the venting was satisfactory, and the casting was not spongy in general, as would be anticipated with insufficient venting, but it occurred only in isolated places which were not always in the same position. Asked by another member whether the trouble was always or usually in the vicinity of joints, MR. ILLINGWORTH replied that it was not so.

The CHAIRMAN said he would increase, although carefully control, the air in the furnace. He said that this was the third case of such a nature of which he had heard recently, and in all cases town's gas was being used.

MR. NIELD asked whether Mr. Illingworth was sure his runner was sufficiently large.

MR. ILLINGWORTH said he had altered it three times already, so he thought that it should be satisfactory.

MR. NEATH suggested that if Mr. Illingworth had not overcome the difficulty by the next meeting of the Branch, he might perhaps be able to bring a section of a casting for examination, as some of the members might then be able to assist him further.

MR. WISE suggested that Mr. Illingworth might make some sort of comparative test between the gas- and the coke-fired furnaces by connecting up the fan with the latter, and leaving all other conditions unaltered.

A MEMBER suggested that the gas be heated before it came in contact with the crucible.

In answer to a question as to time involved in melting, MR. ILLINGWORTH said gas-fired furnaces were twice as fast as those fired with coke.

The CHAIRMAN said that should favour the gas-fired furnace. Personal experience in such matters suggested that something might be achieved by reducing the gas and augmenting the air supply. If fan-driving velocities entered into the matter, a slight adjustment of the burner could alter the zone of combustion and thereby make some improvement.

MR. ILLINGWORTH remarked that his pouring temperature was 1,100 to 1,150 deg. C., and he asked if this temperature was correct.

The CHAIRMAN said that if he was avoiding tin sweat and the heads seemed satisfactory, it did not seem to be seriously wrong, although 1,150 deg. C. seemed to be a little on the high side.

MR. ILLINGWORTH insisted that that temperature was giving the best results.

Porosity in the Bore of a Pulley

MR. S. CARTER stated that on a pulley with a 20-in. face and a boss of 6-in. diameter, porosity occurred. Mr. Carter illustrated the casting on the blackboard, showing where it was porous and asked for an explanation of this phenomenon.

Asked if he had tried the use of pencil runners on the boss, MR. CARTER said he had not, and in reply to a further question he stated that the composition of the iron included 2.2 per cent. silicon, 1.0 per cent. phosphorus and 0.6 per cent. manganese.

MR. J. H. WRIGHT said some years ago he had experienced this difficulty and after trying many methods, a low-phosphorus, low-silicon and a high-manganese content iron was used and cast very hot. Nickel with a percentage of ferro-chrome—which, of course, added to the cost—were also added, and to-day, by using a very low freezing-point iron of this type, they produced many sizes of pulleys satisfactorily. The silicon was just over 1 per cent.

MR. CARTER asked if one could expect to make these castings in a 1 per cent. silicon iron.

MR. WRIGHT replied that this could be done and hundreds of them were machined.

MR. WALKER agreed.

MR. W. FEARNSIDE recalled a series of articles in the FOUNDRY TRADE JOURNAL some years ago in which Mr. E. Longdon discussed the use of denseners and chills to overcome the problem of porosity and shrinkage.

Variation in Length of Castings

MR. COPEMAN asked whether any foundryman present could explain why there was sometimes a substantial variation in the lengths of castings of the same job. In answer to a MEMBER who sketched a personal experience on the blackboard, MR. COPEMAN said in the case he had in mind they were all built up in one structure, not in several cores. This variation in length of castings, of course, made it difficult for the pattern-maker to allow for contraction.

MR. A. S. WORCESTER said he had only experienced this variation in a long type of casting which had to have a heavy core iron.

The CHAIRMAN said there was a liability to obtain a substantial variation in length due to differences in the metal.

A MEMBER said he felt one of the difficulties was the variation in casting temperatures to meet variations in metal. If it was a sluggish metal it would tend to form a larger casting. If they could have the pyrometric control continuously within, say, 50 deg. C., it would be satisfactory.

MR. WALKER wondered whether the difficulty might be caused by cores being too hard.

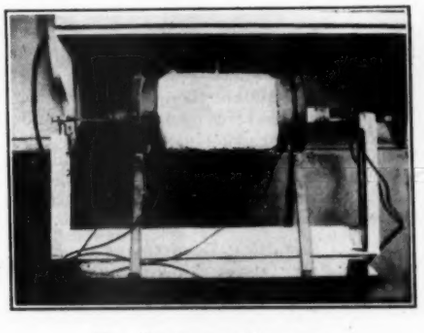
The CHAIRMAN closed the meeting by voicing appreciation to all who had contributed either problems or to the discussion.

Testing Foundry Sands

Due to typographical and other causes, a few errors occurred in Mr. W. Y. Buchanan's article. They are :—Page 408, column 3, 5th line, should read :—

$$\text{Index of ramming} = \left(\frac{\text{dry apparent density}}{\text{true density}}\right) - 42.$$

Page 423, Fig. 10, is a photograph of drying oven; photograph of *expansion* furnace is shown below.



THE EXPANSION FURNACE.

Page 423, column 3, line 23, should read : . . . from Fig. 15 that *oxygen* delays the expansion up to 300 deg. C. Page 425, column 2, "sand handling," line 3, should read : period of 18 months the average silt *extracted from* the sand used was 0.65 per cent.

Recommendations Concerning the Establishment of Costs in a Grey Iron Foundry*

By the Costing Sub-Committee of the Technical Committee of the Institute of British Foundrymen

Constitution of the Sub-Committee

Following a recommendation of the Technical Committee, the principle of the formation of the Costing Sub-Committee was adopted as a result of a resolution of General Council at the meeting held in Birmingham in October, 1932. The Sub-Committee was formed in the year 1933, and met initially on January 13, 1934. The constitution of the Sub-Committee is as follows:—

Mr. C. W. Bigg, Qualcast, Limited.
Mr. F. O. Blackwell, The Davis Gas Stove Company, Limited.
Mr. C. C. Booth, Booth & Brookes, Limited.
Mr. V. Delport (convener), Penton Publishing Company, Limited.
Mr. W. A. Hodson, Leyland Motors, Limited.
Mr. H. J. Roe, Birmingham.
Mr. A. E. Young, British Bath Company, Limited.

SUMMARY

A costing system is the only means of knowing whether costs are recovered in the selling price; of measuring any profit or loss made for a given rate of production; and of knowing what resources may become available out of income for further development.

It is necessary that the costing system should be based on standard principles in order that costs may be established on a comparable basis for the whole industry.

Fundamental Principles.—(A) Each job should be charged with its full costs, including its proper share of overheads; (B) the undertaking should be divided into a number of departments, in each of which the various grades of metal, types of castings, etc., should be classified; (C) all inventories and records should be kept methodically and correctly.

Divisions of the System.—There are four main divisions: (1) melting; (2) moulding; (3) core shop, and (4) cleaning and fettling, together with the following auxiliary departments: pattern shop; maintenance department; heat, light and power; despatch department, etc.

Divisions of Costs.—The costs are divided into two chief groups:—

(1) *Direct costs* are those items which can be charged specifically against a job, and include:—(*a*) *Metal*, which is charged at the actual cost of the metal going into good castings delivered. (*b*) *Moulding and Coremaking*, covering the value of moulding and coremaking labour expended in the making of moulds and cores, and when made specially for the job, moulding boxes, patterns and tackle. (*c*) *Fettling and Cleaning*, against which only direct labour is charged.

(2) *Indirect costs* are those items which cannot be specifically charged against a job, and are an expense of the department to be allocated to the various jobs; in the case of metal and a certain section of the fettling and cleaning department, these are charged on a tonnage basis, and other sections as a percentage on direct labour.

Melting Department

The object of the system, as applied to the melting department, is to arrive at the *cost of the metal at the spout per ton of good castings produced.*

Cost of Metal.—The customer is to be charged with actual cost of the metal going into good castings delivered, plus the metal losses. As regards scrap, the customer is to be charged only with cost of any irrecoverable alloys. The cost of home scrap is the same as the cost of pig-iron and bought scrap mixture going into the charge. Metal costs should be classified as between the various mixtures used.

Cost of Melting.—The customer is to be charged with total melting costs, which include labour, coke, power, materials, etc. From the point of view of melting costs, castings should be classified on the basis of the proportion of good castings to metal melted. The items of direct and indirect costs are:—

MR. V. DELPORT
(*Convener of the Costing Sub-Committee*).

Direct costs: pig-iron; bought scrap; home scrap; alloys.

Indirect costs: labour; fuel; limestone; ganister and supplies; plant maintenance and repairs (labour and materials); laboratory; light and power; loose tools and plant; National Health and Unemployment insurance; supervision; share of fixed charges, etc.

These indirect costs are to be allocated on a tonnage basis to the various classes of castings in the same way as melting costs.

Moulding Department

Direct costs in the moulding department consist of: moulding labour, and those moulding boxes, patterns, tackle and requisites that can be identified specifically with a job. The castings should be classified in accordance with method of making the mould.

Indirect costs: moulding indirect labour (which includes all labour which cannot be directly charged to a job, *i.e.*, shop labourers, crane drivers, etc.); moulding sand, including the cost of preparation; supplies and tools (chaplets, nails, shovels, riddles, etc.); fuel for drying ovens, etc.; moulding boxes, foundry tackle, patterns, except when these can be charged direct to a job; plant maintenance and repairs; National Health and Unemployment insurance; supervision; share of fixed charges.

Indirect costs and fixed charges should be allocated on a direct labour percentage basis.

The Core Department

Cores must be identified with the job for which they are made, and their cost should be applied to the respective jobs. Direct costs, including labour and materials, should be, as far as possible, charged to each job, and core boxes and jigs, etc., made specially for a job should also be charged against that job.

Indirect costs include: coremaking indirect labour, which includes all labour which cannot be directly charged to a job, *i.e.*, shop labourers, etc.; core sand, oils, and compounds, including the cost of preparation; supplies and tools (*i.e.*, sprigs, wire, brushes, shovels, riddles, etc.); fuel for core ovens; tackle; plant maintenance and repairs; National Health and Unemployment insurance; supervision; share of fixed charges.

These should be allocated on a direct labour basis.

The Pattern Shop

The pattern shop is an auxiliary department, and all patterns made for a specific job should be charged to that job. Generally speaking, the same principles apply to the pattern shop as those set out for the core shop. Direct costs include pattern-making material and labour. Indirect costs include pattern-making indirect labour; supplies and tools; plant maintenance and repairs; National Health and Unemployment insurance; supervision, and a share of fixed charges.

The Cleaning and Fettling Department

The cleaning and fettling department covers all operations from the time castings are knocked out of their moulds until they are cleaned and dressed, exclusive of special surface treatment.

There are two sections: (*a*) where labour is the main item of the cost and one casting is dealt with at a time. All costs other than direct labour are to be allocated on direct labour wages basis. Section (*b*) is applied where the main items of cost are power and depreciation of plant and where several castings are treated together. A simple system consists of adding up all the costs pertaining to this section and allocating them to each job on a weight basis. For large foundries castings are to be classified and separated according to time taken, and in each case the cost of operation should be allocated on a weight basis. When castings can be taken out as they are cleaned, such as in sandblasting, they should also be classified in accordance with the time taken, and their cost allocated on a ton-hour basis.

Indirect costs in the cleaning and fettling department include: fettling indirect labour, which cannot be directly charged to a job; supplies and tools (*i.e.*, hammers, chisels, shot, grinding wheels, oxygen, acetylene, welding tools, etc.); fuel; plant maintenance and repairs; National Health and Unemployment insurance; supervision, and a share of fixed charges.

Inspection charges are usually charged to the job and in repetition work they are dealt with as an oncost on productive departments.

In *other auxiliary departments* for generating heat, light and power: the cost per unit is worked out and applied to the various departments, as explained. If a maintenance and repairs department exist, the individual cost is charged against the appropriate section, subsection or job, but for general repairs the cost is an overhead on the appropriate department.

Packing and despatching are considered as an overhead on the moulding department.

Freight can usually be determined for each job and added at the end of the cost sheet.

General Overheads

The comparable production costs are reached at the despatch point. General overheads, such as directors' fees, management and staff salaries, storekeeping, selling costs, financial charges, etc.,

* Paper presented to the Thirty-Fourth Annual Conference of the Institute of British Foundrymen, held at Derby from June 8 to 11, 1937.

are then added on at the end of the cost sheet and allocated as a percentage of moulding and core shop wages.

FOREWORD

It should be unnecessary to emphasise how essential it is for the management of a foundry to have a correct costing system. If no attempt is made to know the actual cost of production, those who are responsible for the fixing of prices and for the finances of an undertaking are completely in the dark as to when the business is operating at a profit or at a loss.

At any time, a correct costing system is necessary, because unless costs are known, one cannot be certain that they are recovered in the selling price. A costing system is the only means of actually measuring any profit or loss made for a given rate of production, and of knowing what resources may become available out of income for further development. Costing also shows in what directions efficiency should be increased and waste eliminated.

A costing system should not be used simply to work out average costs for certain periods; this would be sufficient only in the exceptional case of a foundry manufacturing consistently one class of castings. In the large majority of cases, the production of a foundry comprises several types of castings of different weights, and differing also owing to the grade of the metal and the complication of the casting itself.

Where these conditions obtain, each class of casting should be costed separately; otherwise, and unknown to the management, the profit made on some classes of castings can easily be offset, partly or entirely, by a loss made on other types. If selling prices are based arbitrarily, at so much per ton, on an average cost of production, certain castings will be quoted at a price that will discourage customers, whilst others will be offered at such a low price as to depress the market unfairly for that class of casting. A correct costing system is, therefore, an essential requirement for the individual foundry, and provides an accurate basis for estimating and checking selling prices.

Whilst the necessity for a correct costing system is generally recognised, the benefits to the industry as a whole of a system based on standard principles are not, perhaps, so widely appreciated. By the adoption of such a system, costs can be established on a comparable basis; differences in costs for given types of castings can then be accounted for by the particular circumstances of each foundry, due to proximity of sources of supply, transport facilities, management and efficiency. In fact, a standard cost system would be a measure of a foundry's efficiency, allowing, of course, for the material conditions under which the foundry must operate.

In working out costs over a period, every item of expenditure incurred during that period must be taken into account and absorbed in the cost; the cost figure arrived at for the production during that period will be reliable, provided that the principles governing the system are sound. When costing a given job (as, for instance, a one-ton casting) or when costing for one class of casting, it is possible that only a close approximation to the exact figure can be arrived at. It can be stated, however, that if a correct procedure be used consistently, the cost figure will be sufficiently close in each case for all practical purposes. On the other hand, it must be emphasised that if the costs arrived at by different systems be widely different, only one system may be correct, and all the others are wrong.

A system embodying the principles that have been adopted by experienced firms, which obtain consistently comparable figures that can be interlocked (without discrepancy) with the financial accounts of the undertaking, can be considered as a sound system. It has been the object of this Sub-Committee to elaborate a system based on the best current practice in use by the most up-to-date foundries, and thus to propose a standard set of costing principles which can be adapted to the requirements of various types of foundries, and acceptable to the industry as a whole.

FUNDAMENTAL PRINCIPLES

Three fundamental principles form the basis of the whole system:—

(A) So far as is practically possible, *any expense, including oncosts, incurred in making a job should be a direct charge against that job;* in other words, *each job should be charged with its full cost, including its proper share of overheads.* As a result, overheads should be broken up and allocated in a fair proportion to the various jobs undertaken.

(B) *The undertaking should be divided into a number of departments,* and where a variety of castings is made it is necessary, in each department, *to classify the various grades of metal, and the various types of castings or cores.*

The division of the undertaking into departments makes for a more clear-cut and intelligible system, which makes it easier to trace any potential source of waste or condition of inefficiency. Further sub-division within each department enables the various factors of expenditure to be allocated in such a way that each class of castings will bear its proper cost in conformity with principle (A).

The division into departments and sections does not necessarily entail endless classification of all physical objects; it is mainly a classification on paper, by means of well-thought-out forms and cost sheets, which, once adapted by the management to a particular undertaking, forms the basis of normal clerical work. The classification will be more or less extended in accordance with the circumstances of each undertaking, and, generally speaking, the smaller the foundry the more simple will be the application of the system.

(C) The third principle is equally important as the two first ones, and embodies the methodical and correct keeping of all necessary records and inventories, covering such items as stocks of raw materials, supplies, partly-finished and finished castings, scrap; issues from stores; daily cast reports and records of weights charged into the cupola; job cards; records of wages and times, etc.

Such records and inventories are essential as it is from these that the figures constituting costs are extracted; they are the foundation of the whole system. If records and inventories are not properly kept, then the whole cost system, however sound it may be and however scientifically it may be built up, will give incorrect results—in just the same way that an adding machine will give an incorrect result if the wrong key has been tapped.

Divisions of the System

The manufacture of a casting, owing to its very nature, is the result of a number of definite processes. The metal must be melted; moulds must be prepared in which the metal will be cast; in a large number of cases, cores must be made and placed in the mould. Finally, before being despatched, gates, heads and risers must be removed from the casting, which must have a clean appearance and generally pass inspection. Each of these stages involves a special type of labour and should bear a certain quota of overhead charges or oncosts, besides the actual cost of the labour expended on the particular job.

In applying the principle of classification already enunciated, it is, therefore, natural to divide the undertaking into departments corresponding to those stages. This division enables costs to be checked at each stage, provides for a fair allocation of costs to different types of castings, and also permits of a closer control of the working of each department.

The four main divisions of the system, which apply to any grey iron foundry, correspond to the following departments:—

I.—Melting department.
II.—Moulding department.
III.—Core department.
IV.—Cleaning and fettling department.

In addition, there are a certain number of auxiliary departments that contribute to the proper functioning of the main divisions listed above. Among the most usual auxiliary departments are:—The pattern shop; maintenance department; heat, light and power; and despatch, etc. In the smaller foundries these auxiliary departments need not all be considered separately, but in an undertaking of a certain size, their use clarifies the costing system and enables a better control of operations to be effected.

MELTING DEPARTMENT

Factors Governing Melting Costs

The object of the system, as applied to the melting department, is to arrive at the *cost of the metal at the spout per ton of good castings produced.*

Both for the purpose of estimating a selling price and for calculating actual costs over a period of time or for a given order, the value or cost of all of the following factors that intervene in the operation of the melting department must be known, by means of the properly-kept records and inventories:—

(*a*) Price of the various brands of pig-iron and alloys.
(*b*) Cost value of home scrap.
(*c*) Price of bought scrap.
(*d*) Price of coke.
(*e*) Price of limestone.
(*f*) Price of ganister, bricks, supplies and tools.
(*g*) Wages of all labour employed in the melting department.
(*h*) Cost of repairs and maintenance of melting plant.
(*i*) Cost of power for blowers and other mechanical devices requiring power.
(*j*) Other departmental oncosts which, according to the circumstances of the case, should be charged to the melting department, such as cranes, hoists, whole or part of laboratory expenses, etc.
(*k*) Percentage of fixed charges, which in certain cases should be charged to this department.

The price of items (*a*) and (*c*) to (*f*) should be the price actually invoiced for the materials "delivered at the yard." Any depreciation of stock should be entered into a special account and charged against the stock account of the particular item.

The following records must also be carefully kept:—

(A) Inventories of the stocks of pig-iron, alloys, returned scrap, bought scrap, limestone, ganister, etc.
(B) Weight of each charge going into the cupola, each component being weighed separately.
(C) Weight of gates, runners, risers, wasters, overrun, etc., which return to the stock of home scrap.
(D) Weight of good castings, obtained from the foundry, cleaning and despatch departments, including foundry tackle made.
(E) Daily cast report.

Loss of metal in melting and handling will be calculated from the above records.

The costs of the melting department comprise: (1) cost of metal; (2) cost of melting, and (3) oncosts.

Cost of Metal

The customer should be charged with the actual cost of the metal going into good castings delivered, plus the cost of metal losses aris-

ing from the making of those castings. He should not be charged with the cost of the metal going into the scrap returned to stock, exception being made for high-priced additions. In that case, the total cost of the alloys should be charged, except when the alloy scrap can be used again for a similar type of casting, in which case an allowance should be made, proportionate to the value of the alloy present.

The metal costs include the cost of pig-iron, bought scrap and home scrap, and of any additions (ferros, nickel, etc.) that are charged into the cupola or into the ladle. The cost of pig-iron, additions and bought scrap are obtained from the corresponding inventories. The cost of home scrap will be the average (mean) cost of the pig-iron and bought scrap that go into the charge in the proportion in which they are charged, or, in other words, the cost of the purchased metal going into the mixture.

The cost of metal can be worked out:—(*a*) Directly for the actual tonnage of good castings produced, in which case the cost of metal losses must be added and calculated on the whole charge; (*b*) for the total tonnage of metal charged into the cupola, which will include metal losses, in which case the cost of the scrap returned must be deducted at the same value as the metal mixture. The cost, divided by the tonnage of good castings produced, gives "the cost per ton of the metal mixture going into good castings."

Metal costs should be classified as between the various mixtures that may be used in the foundry. Scrap returned from these mixtures should be stocked separately and used only in conjunction with the mixture from which it originates. This is particularly important in the case of mixtures containing alloys.

Cost of Melting

The customer should be charged with the total melting costs applying to all the metal charged into the cupola for making up his order. Whereas in the case of metal costs the customer is charged only with the cost of the metal going into good castings delivered, plus metal losses, in the case of melting costs he must also be charged with the cost of melting the scrap that is returned to stock, *i.e.*, gates, runners, wasters, overrun, etc., otherwise that cost will not be recovered.

The melting costs include primarily the following items:—All labour employed in the melting department and stock-yard attached thereto; cost of coke; power; materials *ex* stores (limestone, ganister, etc.).

Whether the yield of good castings produced is large or small, melting costs are incurred for all the metal melted; castings should, therefore, be classified on the basis of the production of good castings to metal melted, consideration being given to the relative weight of runners, risers, etc.; the castings should be classified accordingly on the cost sheets, and each class costed separately. The number of classes depends upon the conditions of each undertaking.

To determine melting losses for the various classes of castings, the aggregate tonnage of good castings produced and of all scrap produced in each class should be deducted from the weight of the metal mixture charged into the cupola. The remaining figures will give the melting losses. A general check can be obtained by taking the aggregate stock of pig-iron and of scrap existing at the beginning of the period of costing, plus purchases, and deducting from this tonnage the stock of pig-iron and scrap existing at the end of the period plus the tonnage of good castings produced.

Oncosts

A distinction should be made between departmental oncosts, which apply direct to the melting department, and fixed charges, a share of which is charged to this department. Departmental overheads in the melting department consist mainly of supervising, plant repair and maintenance, laboratory expenses and plant depreciation. The salary of any employee whose time is given to the melting department should be charged to that department.

Plant repair and maintenance covers the cupola plant; cranes and hoists used for the operation of the melting department, which includes the stockyard, blowers, electric gear, etc.

Laboratory expenses must be charged according to circumstances. If a laboratory is used exclusively for cupola control and metal analysis, it should be charged to the melting department. If a laboratory is also used for testing sands, for mechanical tests on castings, for micrography, etc., it should be possible to break up the laboratory expense between the melting department and the foundry, each bearing a share as a departmental oncost.

Melting plant depreciation is, obviously, a departmental overhead and should be added to cost of metal. Fixed charges in the melting department comprise a share of rent or depreciation of buildings, insurance, and local taxation, in proportion to the floor space occupied by the melting plant and the stock-yards (pig-iron, scrap and coke).

Departmental oncosts and fixed charges are allocated to the various classes of castings in a similar way to melting costs. In each class, the total of melting costs and oncosts, divided by the tonnage of good castings produced, gives a cost per ton, which, added to the cost per ton of the metal mixture, gives the "total cost of the metal at the spout per ton of good castings produced."

Application of the System

Cost of Metal.—For each mixture the cost of metal is calculated as shown in Table I.

Cost of Melting and Oncost.—The various items of cost of melting and oncost are added up for a period of costing (Table II).

The castings are divided into classes corresponding to the yields of good castings to metal melted. As the melting costs and oncost increase in proportion to the tonnage of metal melted, the total amount (B) of these items of cost should be divided between each class of castings proportionately to the tonnage of metal melted in each class: it is then a simple matter to divide the melting costs and oncosts in each class by the tonnage of good castings produced in each class, and arrive at a cost per ton of good castings produced.

If a certain job is made from mixture A and comes under Class No. 2, *e.g.*, 65 to 70 per cent. yield of good castings to metal melted, the cost per ton of good castings of the metal mixture A is added to melting costs and oncost per ton of good castings pertaining to Class No. 2, and the result gives "the cost of the metal at the spout per ton of good castings produced" for the job.

(To be concluded.)

TABLE I.—*Cost of Metal.*

MIXTURE "A."

		£	s.	d.	
40 tons	of pig-iron (*a*) at £4 per ton	160	0	0	
20 ,,	pig-iron (*b*) at £3 10s. per ton	70	0	0	
20 ,,	bought scrap at £2 10s. per ton	50	0	0	
80 tons	average price £3 10s. per ton	280	0	0	
40 ,,	home scrap at £3 10s. (average price)	140	0	0	
Iron melted 120 ,,	total cost of mixture	420	0	0	
35 ,,	less scrap returned at £3 10s.	122	10	0	
Iron used 85 ,,	cost of metal going into good castings	£297	10	0	(A)

	T.	c.	q.	
Tonnage of good castings produced (67½ per cent. of total melt)	81	0	0	(T)
Cost of metal per ton of good castings produced $\frac{A}{T}$	£3	13s.	6d.	

Metal loss (for reference) 3.33 per cent. of total metal.

NOTE.—*The above figures are taken at random and for the purpose only of illustrating the application of the system*

TABLE II.—*Cost of Melting and Oncost.*

		£	s.	d.	
Labour, charging, etc.	wages book	8	0	0	
Coke, limestone	price as per inventory	16	0	0	
Plant maintenance and repairs (labour and materials)	at cost	5	0	0	
Ganister, supplies	price as per inventory	4	10	0	
Loose plant	at cost	1	10	0	
Supervision	pay roll	1	10	0	
Light, power	measured or estimated	2	10	0	
Share of fixed charges (rent, rates, depreciation, etc.)	allocated on floor space, etc.	3	10	0	
		£42	10	0	(B)

(Iron melted, 120 tons = 7s. 1d. per ton of metal melted.)

Good castings produced, 81 tons (67½ per cent. of melt) = 10s. 6d. per ton (Class No. 2).

NOTE.—*The above items and figures are taken at random and for the purpose only of illustrating the application of the system.*

Publication Received

A Wall Chart. The Bureau of Information on Nickel, of Thames House, Millbank, London, S.W.1, has made the information contained in Pamphlet No. BB6 available in wall chart form. The system followed has been to list hundreds of various castings usually made in cast iron and to allocate to each a letter. The recommended compositions, together with the tensile strength and Brinell hardnesses, are set out in tabular form against each letter. Moreover, for certain compositions another serial letter is added to indicate a heat-treatment detailed in footnotes. On the reverse side of the chart are indicated the best methods of adding nickel and chromium to cast iron, and finally a table is given which saves all calculations for the addition of nickel, F. nickel and 65 per cent. ferro-chromium related to both "per cwt." and "per ton." A rather obvious typographical error has crept in for three per cent. addition. We congratulate the officers of the Bureau on the intelligent way this wall chart has been set out and produced, and we strongly recommend our readers to write to Thames House for a copy of this publication.

THE SKODA STEELWORKS, of Prague, made a net profit of 46,239,929 cr. last year. The statutory dividend of 5 per cent. is to be supplemented by an additional dividend of 45.5 cr. per share.

Effect of Coke Size in Melting Cast Iron*

By J. A. BOWERS and J. T. MacKENZIE

To determine the effect which the size of coke might have on the chemical analysis and properties of iron as melted in the cupola, a series of test heats were planned and carried out in the research department of the American Cast Iron Pipe Company.

Equipment

The cupola used in all of these experiments was of the portable type lined to 21 in. inside diameter. The tuyeres entered the cupola 5 in. from the bottom of the tap-hole and on opposite sides, each being 90 deg. removed from the tap-hole, which was 1½ in. dia. Details of cupola construction were as described in a previous Paper.[1] Other equipment used consisted of the following:—

(1) Leeds and Northup disappearing filament optical pyrometer with adjustable grid for high range temperature readings; (2) U-tube water manometer calibrated in inches; (3) two 150-lb. hand ladles; (4) 500 lb. capacity Fairbanks scales for weighing iron and coke charges; and (5) five coke screens with openings as follows: 5-in. square, 3-in. dia., 1½-in. dia., 1-in. sq., and 1½-in. sq.

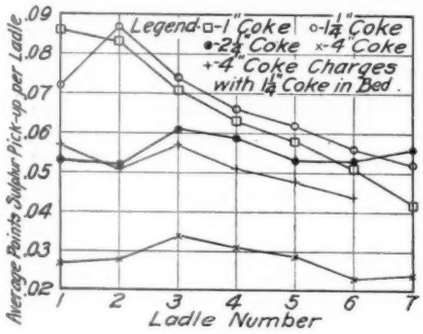

Legend-□-1" Coke ○-1¼" Coke
•-2½" Coke ×-4" Coke
+-4" Coke Charges with 1¼" Coke in Bed
Average Points Sulphur Pick-up per Ladle
Ladle Number

FIG. 1.—SULPHUR VARIATIONS IN HEATS.

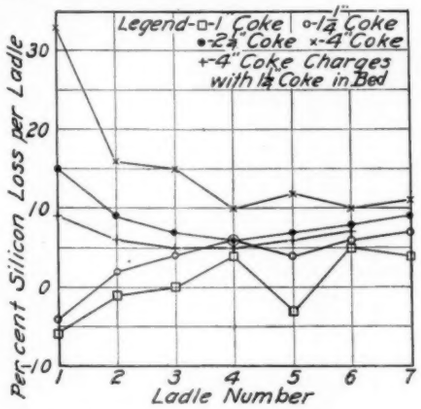


FIG. 2.—SILICON VARIATIONS IN HEATS.

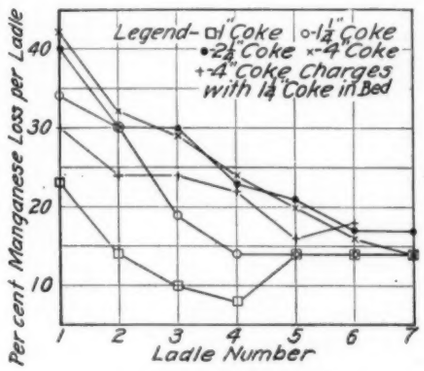


FIG. 3.—MANGANESE VARIATIONS IN HEATS.

Raw Materials and Procedure

Raw materials charged into the cupola were selected and prepared in the same manner for all heats.

Coke.—All coke was taken from the same wagon and screened through a 5-in. screen on a 3-in. screen, through a 3-in. on a 1½-in. screen, through a 1½-in. on a 1-in. screen, and through a 1½-in. on a ½-in. screen. The 1½ by ½-in. coke was used for one heat only and made up the entire bed and charges. In experiments on all other sizes, coke of standard foundry size, 3 in. and upwards, was used up to 12 in. above the tuyeres, and the remaining coke, which included the rest of the bed and a charge, was the size specified for each test. Each coke charge weighed 12.5 lbs., and 2 lbs. of dolomite was used as a flux for every charge.

The analysis of the coke was as follows:—Volatile matter, 0.5 per cent.; fixed carbon, 90.8 per cent.; ash, 8.7 per cent.; moisture, 0.9 per cent.; sulphur, 0.6 per cent.; shatter, 82; porosity, 49.

Iron Charges.—The iron charges were made up of cast-iron pipe about 0.4 in. thick, broken to an average size of approximately 8 by 4 in. Complete chemical analysis was made on each pipe and the allowable variations in silicon and carbon contents of the pipes used for the charges were limited to approximately 20 points for each heat. The proper quantity of this iron sufficient to operate one heat was thoroughly mixed and weighed into 125-lb. charges.

Coke Bed.—Forty inches of coke bed burned red, a short warm-up of 3 to 5 min., and additional green coke to 50 in. above the tuyeres was the general order of procedure.

Charging and Melting.—Charging of coke and iron began immediately after preparation of the bed, and the cupola was filled to the top of the stack. This level was maintained throughout each heat; coke following the last iron charge kept the wind pressure and furnace melting rate normal until the blower was shut down.

At the beginning of the heat, the tap-hole was left open until iron was melted, this being indicated by a continuous spray of iron sparks coming from the tap-hole. Then the blast was shut off and the tap-hole stopped with blacking. This blowing time was included in determining the duration of the heat. Blowing was immediately resumed and the cupola was tapped at a time when the basin was estimated to be full depending on the melting rate of the size of coke used. Iron flowed continuously into hand ladles and an attempt was made to fill these ladles with the same amount of iron as that contained in one charge. Temperature readings were made on the stream of metal at four intervals during the filling of each ladle and the average was recorded.

Wind pressure, as indicated in inches of water on a manometer, was recorded on every ladle and the average converted to oz. per sq. in. pressure. On completion of melting, the cupola blower was shut down and blowing time was recorded.

Test-Bars.—For the purpose of complete chemical analysis, chill depth and iron strength determination, castings were poured from every ladle and the surplus iron was discharged in pig beds. Two chill castings, 3 by 1½ in. and 1½ in. sq., 6 in. long, were poured from each ladle, except on heats of long duration when chills were poured from every other ladle. In addition to these, 2 by 1 in. test-bars 26 in. long, moulded in sets of four, were cast at intervals. The moulds for the test-bars were dry-sand with a facing of wet clay-bonded coke blacking dried with the mould. They were cast vertically through a dry-sand runner core equipped with a strainer and gated at the bottom.[2]

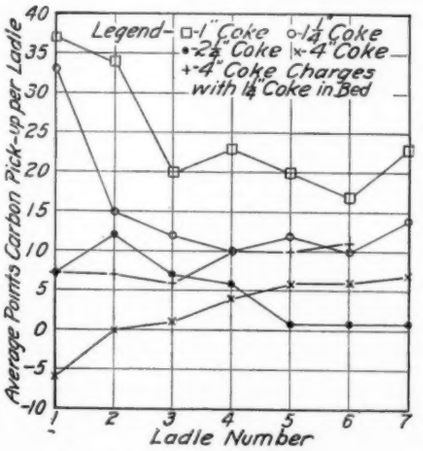


FIG. 4.—CARBON VARIATIONS IN HEATS.

Analytical Procedure

Analysis of Pipe Scrap for Charging.—On each pipe to be broken for charging, silicon, evolution sulphur, and total carbon were determined. On a combination sample made up of representative drillings from all pipe to be charged in one heat, silicon, phosphorus, manganese, and total carbon were run in duplicates; and, in addition, sulphur, by both evolution and gravimetric methods, was determined.

Analysis of Iron Tapped.—Each ladle tapped from the cupola was analysed in duplicate for silicon and total carbon, and once for evolution sulphur and manganese. Every set of test-bars was analysed for silicon and total carbon in duplicate; and the evolution and gravimetric sulphur, phosphorus and manganese were determined. In case of any undue variation from the expected results, thorough check analyses were made on another set of drillings on all samples.[3]

Discussion of Results

In this discussion, and as shown on the accompanying illustrations, the different sizes of the coke are quoted as a definite figure for the sake of brevity. This figure was arrived at by adding the size of the large screen to that of the small one and dividing by two; for instance, the smallest coke used passed a 1½-in. screen and remained on the ½-in. and is designated as 1-in. coke.

One Inch Coke.—Only one heat was made using this extremely small coke (1½ by ½ in.), due to the difficulty of lighting off and to the fact that the iron melted cold throughout the heat. It was further decided after this heat to use standard size coke, 3 in. and up, to 12 in. above the tuyeres. Sulphur pick-up, although de-

* Extracted from a Paper read before the Milwaukee Annual Conference of the American Foundrymen's Association. The authors are melting superintendent, American Cast Iron Pipe Company, and chief chemist and metallurgist, American Cast Iron Pipe Company, respectively.

1 Johnson, H. V., and MacKenzie, J. T., "Effects of Tuyere Heights on Carbon Pick-Up in the Cupola," Trans. A.F.A., Vol. 44, 1936), pp. 178–190.

2 A. I. Krynitsky and C. M. Saeger, Jr., "An Improved Method for Making Test-Bars," A.F.A. Preprint 37–5, 1937, also Jnl. of Research, Bureau of Standards, Vol. 16, No. 4, 1936.

3 In all determinations, A.S.T.M. Standard Methods were used.

creasing continually from the first ladle, was very high with this small coke.

Results of silicon determinations indicate that there was very little oxidation of the elements on this heat, as the average silicon analysis for the entire seven ladles was exactly that of the charge. The manganese loss was probably due entirely to its combination with sulphur. The carbon pick-up was rather high on this heat, but this was partially due to the comparatively low carbon equivalent (total carbon + 0.3 silicon + 0.3 phosphorus) of the charge (3.80 per cent.). The temperature of the iron was low throughout the heat.

One and One-Quarter Inch Coke.—The next two heats were made using coke that passed the 1½-in. and remained on a 1-in. screen. The second of these two heats was one of two long heats (20 charges) conducted to study the effect of length of heat on resulting analyses. The first seven ladles, however, were treated in the same manner as those from the other heats. The increase in temperature of these two heats as compared to the first was quite apparent. This increase amounted to approximately 55 deg. C. The sulphur pick-up was higher on these two heats than on the one with the smaller coke. This was probably due to some extent to the higher temperatures.

The sulphur pick-up again decreased as the length of the heat increased, but not so rapidly as on the first heat. Although the silicon loss was somewhat higher, it was only about half that when using 2¼ in. coke. The manganese loss was rather high, approximately 23 per cent, probably due to the high sulphur. The average carbon pick-up for these two heats was considerably lower than the first heat, but may have been partly due to the higher carbon equivalent of the charges in the last heat.

Two and One-Quarter Inch Coke.—The heats were made on coke that passed a 3-in. screen and remained on the 1½-in., *i.e.*, 2¼-in. coke. The sulphur pick-up was noticeably lower with this larger coke, although it did not diminish on each succeeding ladle as in previous heats. The silicon loss increased to approximately 9 per cent., but this size coke gave the best results from an operation standpoint and was used as the basis for comparison with other heats. Since the manganese loss increased slightly, about 25 per cent., with the lower sulphur content, there must have been some oxidation in the stack. The carbon pick-up continued to decrease with this increase in coke size.

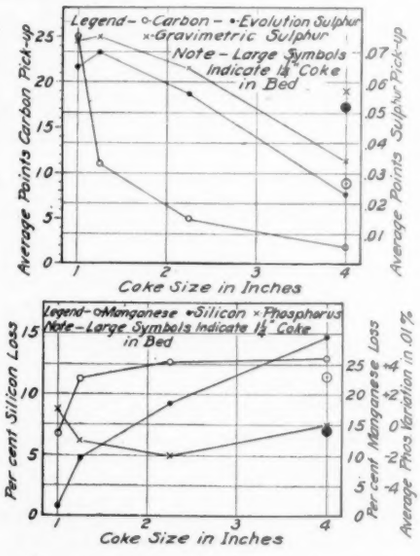

Legend-○Carbon-•Evolution Sulphur
×Gravimetric Sulphur
Note-Large Symbols Indicate 1¼" Coke in Bed
Average Points Carbon Pick-up
Average Points Sulphur Pick-up
Coke Size in Inches
Legend-○Manganese •Silicon ×Phosphorus
Note-Large Symbols Indicate 1¼" Coke in Bed
Per cent Silicon Loss
Per cent Manganese Loss
Average Phos Variation in .01%
Coke Size in Inches

FIG. 6.—AVERAGE CHANGES IN ANALYSIS WITH EACH SUCCEEDING CHANGE IN COKE SIZE.

Four Inch Coke.—Three heats were made using 4 in. coke. One of these heats was 20 charges in length to use as a companion heat to the one with small coke. The sulphur pick-up continued to decrease as the coke size was increased and, as with the 3 by 1½ in. coke, did not diminish as the age of the heat increased. The increase in silicon loss was considerable with this coke, averaging 14.5 per cent., which is rather high when compared to the 9 per cent. loss with 2¼ in. coke.

The manganese loss was very high, averaging 27 per cent. This is somewhat higher than with 2¼ in. coke and, coupled with the fact that the sulphur was much lower, leads one to believe that there was excessive oxidation in the stack with this large coke. The carbon analyses varied from a pick-up of 13 points to a loss of 13 points. This was partly due to the 0.34 per cent. difference in carbon equivalent of the charge. However, the average of the three heats shows a definite decrease in the carbon pick-up with this coke. The average temperature of the iron from this set of heats decreased when compared with 2¼ in. coke.

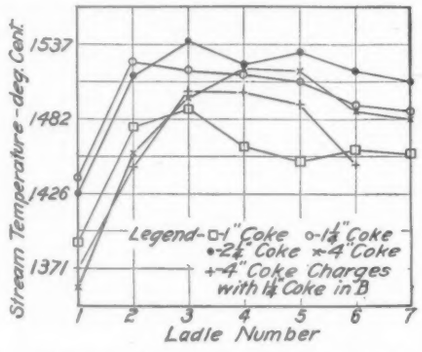


FIG. 5.—VARIATIONS IN TEMPERATURE WITH DIFFERENT COKE SIZES.

Large Coke in Bed

To check the effect of the large coke placed in the bed of the cupola on all these tests, two heats were made with 8 and 12 in. of 1¼ in. coke in the bed and using 4 in. coke for the balance of the bed and for the succeeding charges.

Although there was no appreciable difference in the amount of sulphur pick-up on these two heats, considered individually, their average was considerably higher than that with the larger coke in the bed. The 6.5 per cent. silicon loss of these two heats is a sharp decrease from the 15 per cent. of the companion heats with large coke in the bed. The manganese loss of 23 per cent. was slightly lower in spite of the higher sulphur; the average carbon pick-up was somewhat higher.

Average Results

Figs. 1, 2, 3, 4 and 5 are graphical representations of the average results for each ladle of all the heats for the different sizes of coke. The results of the last two heats are shown with a dotted line. These graphs disclose several interesting facts. Fig. 1 shows clearly the extremely high decrease in sulphur pick-up, after the first two ladles, with the small coke. The dotted line curve for the last two heats is interesting, due to the fact that it is so much higher than its companion curve with 4 in. coke.

The most interesting feature of Fig. 2 is the low silicon loss by using small coke to start the bed. The decrease in the loss of this element on the first ladle is especially striking.

The manganese loss curves in Fig. 3 in most instances show a decrease from the first ladle and do not flatten until the fifth or sixth ladle. The manganese loss on the heats with small coke in the basin was much less, especially on the first part of the heat, than on the other heats with 4 in. coke.

The carbon pick-up curves of Fig. 4 show the relative change in the amount of pick-up of this element by changing the size of coke. The curve for the two heats with small coke in the bed indicates the slightly higher pick-up when compared to the other curve for 4 in. coke.

In Fig. 5, the average temperature of each ladle is plotted for the different sizes of coke. One of the features of this graph is the low spout temperatures throughout the heat on the extremely small coke. This graph also shows the superiority of the 2¼ in. coke for high temperatures.

Summary Graph

Fig. 6 might be termed a summary graph, as it gives the grand average of the changes in analyses with each succeeding change in coke size. This graph discloses the fact that the sulphur pick-up was approximately the same on the first two sizes of small coke and then decreased rapidly in approximately direct proportion to the increase in coke size. Another interesting fact seen is the similarity of the two lines constructed from the different methods for determining sulphur. Although the gravimetric determination is 9 points, on the average, higher than the evolution method, the two determinations form practically parallel lines. The enlarged points on this part of the graph are the average for the two heats with small coke in the bed. They show clearly the increase in sulphur pick-up on these tests.

The carbon pick-up curve, after a tremendous drop from the smallest coke to the next larger size, flattened rapidly, although continuing to decrease, with further increases in coke size. Due to the fact that the average carbon equivalent of the charges for different sizes of coke varied 32 points, this curve is not wholly reliable. This difference would be reflected more in the extremely large drop from the one to the 1¼ in. coke than for the balance of the curve. The reason for this is that the variation in carbon equivalent for the average of the different series, excluding the first heat, was only 15 points. The increase in carbon pick-up for the heats with small coke in the basin is indicated by the enlarged open circle. This increase was in spite of the fact that the carbon equivalent of the charge for these heats was considerably higher than that for the other 4 in. coke heats.

The silicon loss curve is practically the reverse of the carbon pick-up curve. The loss of silicon increases rapidly with the first increase of coke size, and the curve then flattens out with the loss, increasing in practically a straight line with each additional increase in coke size.

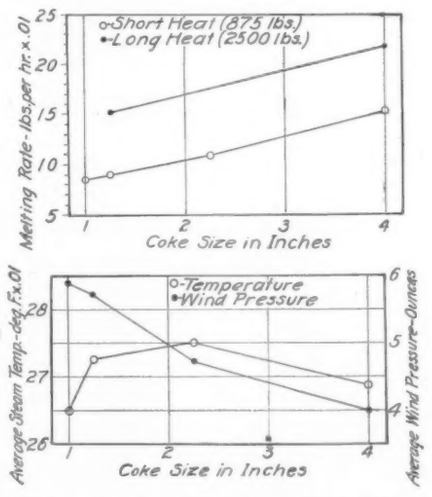


FIG. 7.—MELTING RATE FOR DIFFERENT COKE SIZES.

The extreme decrease in silicon loss of the last two heats is shown clearly by the large solid circle. The curve for the manganese loss was almost parallel to the silicon loss curve to the 2¼ in. coke, but no further loss of this element was seen in increasing the coke size to 4 in.

Melting Rate

Fig. 7 shows the melting rate for the different coke sizes, separating the two long heats from the short ones. The temperature curve is the next most interesting, and this curve shows that the 2¼ in. coke gave the highest temperature average. This average was 13 deg. C. higher than heats with the 1¼ in. coke and 28 deg. C. higher than the 4 in. coke. The wind pressure curve shows that the pressure decreased as the coke size increased.

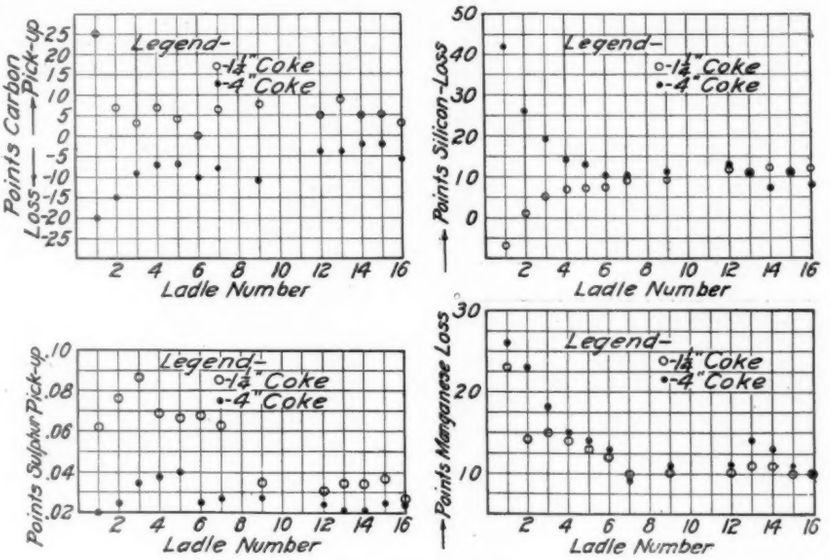


FIG. 8.—VARIATIONS IN DIFFERENT ELEMENTS IN HEATS OF LONG DURATION WHEN USING VARIOUS SIZED COKES.

Change in Elements in Heats of Long Duration

Fig. 8 gives four sets of curves for the change in the different elements on heats of comparatively long duration when using the small (1¼ in.) coke and the large (4 in.) coke.

Carbon.—The carbon curve for the 4 in. coke shows a loss of carbon throughout the heat. This is the only heat of the entire set in which there was a loss of carbon. This carbon curve follows very closely the temperature curve shown in Fig. 9. The carbon loss diminishes rapidly from the first to the fourth ladle and then approaches a straight line, as does the temperature curve. The carbon pick-up from the second ladle throughout the heat on the 1¼ in. coke was within 5 points of a straight line after an enormous pick-up on the first ladle.

Sulphur.—The sulphur pick-up curves show that after the tenth ladle, the amount of sulphur absorbed was approximately the same on both the large and small coke. The fact that the sulphur pick-up increased from a comparatively low amount on the first ladle, for three or four ladles, may be explained by the fact that standard foundry coke was used to 12 in. above the tuyeres. The curves for the silicon loss with the 4 in. coke, after an extremely high loss of 40 points, decreased sharply to the sixth ladle, and then ran along a straight line. This curve for the small coke, beginning with no loss on the second ladle, increased through the sixth ladle and then coincided with the curve for 4 in. coke for the remainder of the heat. This is an interesting fact and leads to the supposition that the larger coke becomes packed or more compact, thus closing up the voids so much that the blast cannot go through with enough velocity to impinge on and oxidise the metal.

Manganese.—The manganese loss curves approximately coincide throughout the heat. However, it should be pointed out that the extremely high loss of the first few ladles of both heats was probably due to entirely different causes. The high loss on the small coke was probably due entirely to the high sulphur as explained before. This loss at the beginning of the heat with 4 in. coke was probably due to oxidation to a certain extent, as confirmed by the fact that there was a high loss of silicon also during this period.

Temperature.—Fig. 9 gives the temperature curves for the two heats by ladle number. No explanation has been found for the temperature drop after the first few ladles.

Physical Properties.—Fig. 10 shows the average carbon equivalent, breaking load, deflection at 1,900 lb. load, and Brinell hardness curves for the 2 by 1 in. test-bars for different coke sizes. These test bars were broken on 24-in. supports, centrally loaded, and the maximum variation in the average breaking loads was less than 200 lbs. This is considered a rather small variation in view of the fact that there are so many variables that affect the breaking loads of test-bars. The breaking load and deflection curves follow the carbon equivalent curve closely enough to lead to the supposition that the iron was not otherwise affected by changing coke size. The Brinell hardness curve was plotted on a descending scale to show its similarity to the carbon equivalent curve.

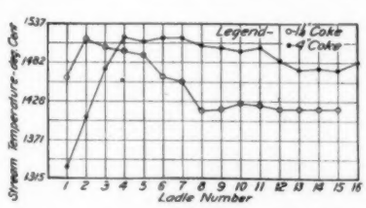


FIG. 9.—VARIATIONS IN TEMPERATURE IN HEATS OF LONG DURATION WITH VARIOUS SIZED COKES.

Conclusions

These conclusions are applicable only on a 21-in. dia. cupola, constructed and operated as in these tests. However, they should indicate the general trend of results for any cupola when changing from one coke size to another.

The following would hold true for heats of comparatively short duration only:—

(1) The sulphur pick-up increases with each decrease in coke size.

(2) The silicon loss decreases with each decrease in coke size.

(3) The amount of carbon pick-up increases with each decrease in coke size.

(4) The manganese loss decreases with each decrease in coke size. This may be offset to a certain degree by the higher sulphur when using small coke.

(5) The spout temperatures reach a maximum with some intermediate coke size probably depending on the size of the cupola and the blast pressure or velocity.

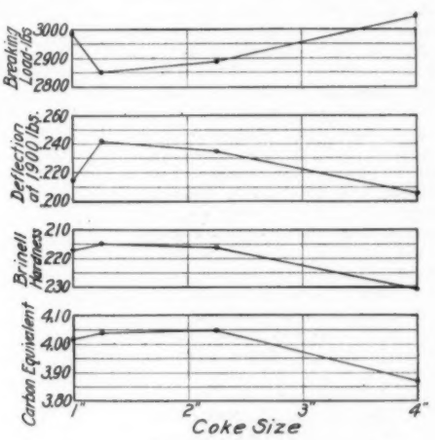


FIG. 10.—PHYSICAL PROPERTIES OF IRONS PRODUCED, USING COKE OF VARIOUS SIZE.

(6) Melting speed is reduced when the coke size is decreased.

(7) The blast pressure naturally increases with each decrease in coke size.

The most outstanding conclusion to be drawn for heats of longer duration is that after the first eight to ten ladles, the changes in the elements are practically unaffected by changes in coke size. This is particularly true of the silicon and manganese. The sulphur and carbon pick-ups increase slightly when changing from the largest to the smallest size coke.

Other information obtained from the longer heats is as follows:—

(1) Spout temperatures change with changing coke sizes.

(2) Melting speed is decreased by decreasing coke size.

These experiments further indicate that there is an optimum size for the coke to be used in a given cupola. When this size is found, maximum temperatures will be reached and better and more even cupola operation obtained. The best size for the cupola used in these experiments is 2 to 3 in.

The authors wish to thank all those who helped in making these tests, particularly R. H. Elder and Roy E. Deas[4] for their work in making the chemical determinations.

Stainless Steel Restrictions in Germany

The German Government has now prohibited the manufacture of certain articles from stainless steel for the domestic market. This restriction is apparently aimed at those stainless steels which contain nickel, because this metal is scarce in Germany. Stainless steels containing chromium and manganese, but no nickel or not more than 1.50 per cent. of nickel, can be used until further notice except in certain products.

[4] Analysts, American Cast Iron Pipe Company.

Trends in the Non-Ferrous Foundry*

By Dr. L. B. HUNT, M.Sc., A.M.I.A.E.

To attempt to outline the current trends of development in the non-ferrous foundry is an unenviable task, if only for the reason that it is almost impossible to arrive at a satisfactory definition of the non-ferrous foundry. The activities and outlook of the small brass foundry, for example, are obviously very different from those of the firm producing large quantities of aluminium or magnesium alloy castings for the special requirements of the motor vehicle and aircraft industries, while the production of zinc-base pressure die-castings involves a further set of factors but must necessarily be included as an important section of the industry. Each branch has its own problems and each is making its own developments; these are well known to those engaged in the individual sections of the industry, but it will be readily admitted that many of the principles underlying foundry technique and progress in these more or less water-tight compartments are essentially the same. For this reason the author will attempt to meet the request for a Paper dealing in a broad way with present trends and probable future developments by describing what appears to him as the most important factors bearing upon the manufacture of cast non-ferrous metal products in general, but with particular reference to those developments which, now fully apparent in one branch of the industry, show promise of more widespread influence in others, and also to certain developments in competitive materials and fabricating methods as they affect the non-ferrous foundry.

It will be convenient to group these factors under three headings, covering (1) materials, (2) methods, and (3) products. A certain amount of overlapping is unavoidable, but this appears to be the most logical system upon which to base such a discussion.

I. MATERIALS

The objectives in all foundry work may be taken as improvements in soundness, strength and economy. In what ways are the metallurgical materials available to the non-ferrous foundry to-day contributing towards the attainment of these objectives? Among the most important factors are the remarkable improvements in the purity of the primary metals during the past few years, and the development of new and improved alloys of high strength properties. The great strides that have been made in the production of high-purity metals have not all been of immediate practical value to the foundry, however; oxygen-free high-conductivity copper, for example, containing less than 0.004 per cent. of impurities, and melted and cast in an inert atmosphere, obviously cannot be re-melted for foundry use and still remain the same product, while the high-purity aluminium produced by the Gadeau process, and averaging over 99.99 per cent. purity has not yet found any foundry applications, although it will quite probably find employment in the production of special alloys before long. However, aluminium of over 99.8 per cent. purity has been made available by the exercise of careful control in the production of alumina from bauxite, in the production of carbon electrodes, and in the reduction of the metal.

The outstanding achievement that concerns foundrymen is the production of 99.99 per cent. zinc by the process of fractional distillation. It has been established that the production of successful zinc-base die-casting alloys demands a very high-purity basis metal, and for this reason a plant was laid down in this country in 1934 by the Imperial Smelting Corporation, Limited, for the further refining of the zinc produced by the vertical-retort process. By the fractional distillation process a zinc is produced with a purity well above 99.99 per cent., lead having been reduced to well below 0.001 per cent. while cadmium and iron remain to the extent of about 0.001 per cent. Great care is, of course, taken in the subsequent production of the die-casting alloys that no contamination takes place, and similar care is necessary in the use of these alloys in the die-casting shop. The result of this development has been a marked improvement in the physical properties of the alloys, freedom from intercrystalline corrosion, and dimensional stability under adverse atmospheric conditions.

Internal Competition

Internal competition among the primary metals is a factor worthy of some consideration. This is affected not only by technical advantages and limitations but also by questions of availability and price. Aluminium casting alloys have, of course, eaten somewhat into the field of the brass and bronze foundry, as into that of the iron foundry, and have recently been assisted in this by the high price of copper. Although no statistics are available, it is known that the consumption of aluminium alloy sand- and die-castings has increased very markedly during the past few years. The use of aluminium-alloy cylinder-heads is increasing, but an interesting movement in the opposite direction is the tendency—chiefly in the United States—to turn to copper as a basis for motor vehicle cylinder heads. High-conductivity copper alloys, containing a small percentage of chromium, have been employed for this purpose.

DR. L. B. HUNT, M.SC.

The increasing consumption of magnesium alloy castings is reflected in the steps which have been and are being taken to produce magnesium in this country on a large scale. It is likely that a reduction in the price of this metal will eventually result from these activities, and will be followed by a further increase in consumption.

The rapid growth in the consumption of zinc-base die-casting alloys over the past few years has not been at the expense of other non-ferrous metal products to any appreciable extent, but rather at the expense of cast iron, malleable iron and, more recently, of sheet steel pressings. Consumption of these alloys has increased from about 6,000 tons five years ago to 13,000 or 14,000 tons per annum at the present time, the major part of this increase having taken place over the past two years, or since high-purity zinc has been available.

Secondary Metal

Many of the requirements of the non-ferrous foundry are met by secondary metal of one kind or another, and here a noticeable and desirable tendency is towards the production of secondary ingots by refiners specialising in this business. With increasing control of the virgin metals available, the varied nature of the scrap entering the foundry becomes increasingly dangerous, and must obviously be avoided as far as possible. The obvious solution to the difficulties presented by this problem and by the increasing quantities of re-worked metal in circulation is to turn the whole problem over to the specialist, who will in any case have many subsidiary problems to tackle in connection with the control of his furnace atmospheres and the action of his fluxes. If these be handled thoroughly, there is no reason why secondary alloys having excellent and consistent physical properties should not be produced.

New and Improved Alloys

The non-ferrous foundry is constantly being provided with improved materials as the result of continuous research on the constitution and properties of the alloys of the principal basis metals. The range of high strength non-ferrous casting alloys was well described by Murphy[1] in 1935, and need not be reiterated here. In the case of aluminium alloys in the past year or two the major tendencies have been the increasing use of heat-treated alloys, improvements in the heat-treatable aluminium-silicon alloys containing from 6 to 10 per cent. of silicon, and the use of grain-refining additions such as titanium and cerium. Gwyer and Dyson[2] report that the heat-treated silicon alloys show definite advantages over some of the other heat-treated alloys, are easier to cast, give less trouble in the foundry, and seem less liable to develop internal cracks and strains on quenching from high temperatures.

Several new magnesium alloys are in course of development, including a cerium-cobalt-manganese alloy which retains an appreciable proportion of its strength at temperatures up to 300 deg. C., and is stated to be suitable for pistons. Improvements are needed and may be expected in magnesium alloys particularly suitable for pressure die-casting.

Mould Materials

The increasing attention which is being given to the treatment and control of moulding sands is too well known to foundrymen to require emphasis. This is only one example, in fact, of the major tendency towards greatly increased precision and control which characterises all the activities of the non-ferrous foundry.

In addition, there is evidence of a slow but valuable increase in the knowledge of the properties of sand, particularly at those temperatures at which it is really important to know something more about them—the temperatures at which castings are poured. Hudson[3] has published the results of his investigations on this subject, and has indicated possible methods for controlling the properties of mould and core materials at elevated temperatures with the object of eliminating or minimising scabs, hot tears, dimensional inaccuracies and other defects.

Considerable interest is being taken in the possibilities of using materials other than sand for moulds. The Randupson process, employing a weak type of concrete, gives a more rapid rate of solidification than sand, and a greater permeability. Quite recently Hudson[4] has de-

* Paper presented to the Thirty-Fourth Annual Conference of the Institute of British Foundrymen, held in Derby from June 8 to 11, 1937. The author is Editor of "The Metal Industry."

scribed an investigation of several plastic moulding compositions in respect of their thermal conductivities. From this work it is established that the commonly-used moulding sands have a low and fairly constant thermal conductivity, and that it is a practical proposition to produce plastic moulding compositions having a conductivity superior to that of steel and almost equal to that of copper. Such mixtures, based upon graphite or carborundum with additions of bentonite and a liquid binder, can be used repeatedly, and will undoubtedly warrant further investigation and trial.

In the die-casting branch of the industry the mould material problem is more or less acute, and improved die steels are constantly in demand. Steels are required which will withstand rapid heating and cooling, have a high thermal conductivity, and be machinable in the soft state. The difficulties encountered naturally vary with the casting temperatures employed, and become apparent with the aluminium alloys. With the copper alloys, however, the die steel problem is actually the limiting factor, and any further developments in brass pressure die-casting will be entirely dependent upon the provision of improved mould materials.

II. METHODS

When considering the methods employed in the non-ferrous foundry, the factor previously apparent—increasing precision and control—is again in evidence, but is accompanied by another major factor, the tendency towards the planning of operations in advance by foundry engineers and the consequent smaller part played by the skilled operative. It is not proposed to enter into a discussion of the relative merits of the various types of melting equipment now available, but it can be said that in choosing such equipment, the tendency is to give greater consideration to the possibilities of rigid control of the furnace atmosphere, pouring temperature and composition of the charge rather than to the question of first cost. The ideal melting conditions are obviously those in which contamination of the melt is impossible, and electric arc, resistance and induction furnaces offer considerable advantages in this direction. At the same time, by reason of marked improvements in the manufacture of crucibles and in the design and construction of furnaces, the possibilities of contamination by gaseous or non-metallic impurities have been considerably reduced with other types of melting equipment.

Cleansing Methods

It is well known that considerable research has been carried out on the contamination of melts, particularly of aluminium alloys, by gases, and a number of methods have been devised and operated with more or less success for the removal of these gases. This is really only one aspect of the whole problem of the "cleansing" of melts, or of what has been described by Prof. Hutton as "sanitary metallurgy," and one of the most important factors in the near future is certain to be that of the application of more fundamental knowledge of gas-metal equilibria to non-ferrous foundry practice. Part of this tendency may already be observed in the attention given to contamination by gases during melting, but it is most likely that improved and probably simpler methods of removing gases will be developed, while at the same time greater control of shrinkage and the position of shrinkage cavities is likely to be obtained.

The precise action of deoxidisers and fluxes in the removal of impurities also requires much further study and elucidation, and when more is known of the mechanism of these reactions an appreciable improvement in the soundness, consistency and physical properties of castings may be expected. The remarkable results obtained by Lepp[6] give some idea of the possibilities. The suggestion has been made more than once that molten metal should be actually shaken up with solvent fluxes, much as the chemist uses his separating funnel, and as it is apparent that the efficiency of fluxes depends largely upon the intimate mixing of flux and metal, this idea may quite possibly find application in certain branches of the non-ferrous foundry. Whether or not such shaking is resorted to, however, it is substantially certain that more efficient mixing must be achieved before the full benefits of deoxidisers and fluxes are realised. Looking rather a long way ahead, it is possible that advantage may be taken of the properties of supersonic waves—sound waves of such high frequency that they are well beyond the limit of audibility—in bringing about the required degree of agitation of metal and flux.

An extensive amount of literature exists on non-metallic inclusions in steel, but metallurgical authors generally maintain a discreet silence on the subject of oxide, sulphide and similar inclusions in non-ferrous metals and their effects on structure and properties. An important field for investigation exists here, and should one day yield results of value to foundry metallurgists.

Professor Hutton[8] has suggested the actual filtration of molten metals, and while this may be more suited to the production of billets for rolling, etc., it is a possibility to be borne in mind in the foundry. In fact a desirable tendency would be to regard molten metals in much the same light as the chemical engineer regards his solutions. Chemical engineering technique has been successfully adapted to the purification of molten zinc by fractional distillation, and there appears to be further scope for the application of such technique to the purification of metals for foundry use.

Moulding and Pouring

The tendency towards the employment of the unskilled or semi-skilled machine moulder and the ordered planning of moulding and running methods by the technical staff of the foundry shows, of course, every sign of continuing to its logical conclusion in all but the smallest of jobbing foundries or in those foundries where conditions are obviously unsuited to such methods by reason of the unusual size or nature of the castings produced. In this, the foundry is but following the machine shop, in which every operation is foreseen and provided for. Foundry planning may not be by any means so simple a matter as this, but its advantages cannot be denied, and it is certainly coming to stay. Probably the greatest difficulty is in finding the right type of man for such work, as he must be something of the engineer, the foundryman and the metallurgist; he must stipulate in advance the precise method of moulding to be employed, the type of pattern equipment required, the disposition of gates and risers, the pressure of ramming and the nature of the sand to be used. It is quite probable that, partly as a result of the educational facilities now available in foundry practice, a new type of foundry engineer will slowly develop to fill this kind of post. His most important requirement will, in the author's opinion, be the ability to visualise the flow of molten metal in a mould, and thus the optimum conditions for pouring and running any particular casting, so as to obtain progressive solidification and a sound casting with the absolute minimum of preliminary experiment or adjustment.

At the present time it has been found necessary to devise special running methods for particular groups of aluminium alloys, and this tendency towards more or less standardised practice for special materials will undoubtedly continue.

Casting methods for ingots and billets of aluminium and copper have received considerable attention in the last few years, and a number of improved methods have been evolved to ensure the slow and steady flow of metal into the mould. In the foundry, however, very little attention has been paid to improving the methods of pouring that have been in use for generations, although it appears to be a reasonable assumption that similar methods of mechanised pouring, suitably modified from those employed for billets, should find application in the progressive foundry.

One very marked trend in the production of cast non-ferrous products is, of course, the application of pressure to both pouring and solidification, and the consequent transfer of certain types of products from the sand foundry to the pressure die-casting shop, and the capture of several markets from the iron foundry and the press shop. The technique of pressure die-casting does not require description here, but its advantages—high-speed production, dimensional accuracy, good surface finish, economy and elimination or reduction of machining operations—have rapidly made it a most important branch of the non-ferrous foundry. The main tendencies of recent years have been towards higher pressures and thus greater freedom from unsoundness, and the use of hydraulically-operated machines. With modern machines die-castings of virtually perfect soundness can be produced, while the production of brass pressure die-castings has been made practicable.

III. PRODUCTS

To enlarge upon the improvements in the mechanical properties of non-ferrous castings during the last few years would be merely to stress the obvious. As with cast iron and other materials, cast non-ferrous products are providing engineers and other users with materials of marked superiority to those of several years ago, largely, of course, owing to the developments and improvements which have been referred to earlier in this Paper, but particularly on account of the attention given to soundness, grain refinement and heat-treatment. In the recent discussion on light alloys at the London Congress of the International Association for Testing Materials, for example, Murphy emphasised the very great advance that had taken place in the heat-treatment of magnesium alloy castings on a large scale, and the consequent improvement in proof stress obtained, while Sutton drew attention to the remarkable improvement in the fatigue resistance of both the aluminium and the magnesium alloys. There is a conspicuous gap in the available knowledge of one property of these materials, however—their sensitiveness to stress concentration effects due to notches and rapid changes of section. It is realised that aluminium alloys are generally more susceptible in this respect than copper alloys, while magnesium alloys are still more sensitive, but little or no real data exist on the matter. The related property of damping, in which cast iron shows up so well, also requires further investigation as regards the non-ferrous casting alloys.

The grain refining influence of such additions as titanium and cerium on aluminium alloys and the modification of the aluminium-silicon alloys have led to some speculation on the possible application of the same idea to the copper alloys. Lorig and Dayton,[7] for example, have reviewed the possibilities of modifying brasses and bronzes with small additions of iron, manganese, molybdenum, tungsten and other sparingly soluble metals to bring about grain refinement, greater uniformity in structure and freedom from segregation. To some extent, of course, the manganese brasses (improperly called manganese bronzes) represent a step in this direction.

Basic Properties

Much further knowledge is required of the properties which can reasonably be expected from perfectly sound and pure cast alloys, *i.e.*, of the ideals towards which developments can be directed. A good beginning has been made in this work by the British Non-Ferrous Metals Research Association,[8] who have carried out preliminary work to ascertain the properties of pure and gas-free bronzes and have obtained some very high strength and density figures. Starting from this datum line it is proposed to ascertain accu-

rately the influence of external factors, particularly gas atmospheres, on the physical and mechanical properties of foundry bronzes.

Competitive Methods and Materials

One of the most interesting studies connected with the non-ferrous foundry lies in attempting to follow the ebb and flow of competition from alternative methods of production. Whatever progress has been made in the foundry in recent years, it must be conceded that still greater progress has been made in the various plastic working methods taken collectively, and in methods of joining—soldering and welding. The most outstanding feature is the increasing use of the power press in one form or another, and the non-ferrous foundry industry has undoubtedly lost some of its territory to the producers of hot brass stampings, aluminium and magnesium alloy forgings and other wrought materials. To a certain extent this is inevitable with the advancing technique of plastic working, but at the same time the foundry itself must be held responsible for the loss of certain markets.

Not many years ago engineering design was very largely a question of choosing a casting or a riveted structure; any not-too-recent text book on machine drawing and design will clearly demonstrate this. With the rise of the production engineer and the development of a much wider range of fabricating methods, however, designers have been given very much more scope, and a new concept of the utilisation of methods and materials has grown up. In addition to those mentioned above, therefore, the foundry has to meet the onslaught of sheet metal working methods, extrusion—which is producing more complicated sections almost daily, and can now provide closed sections in aluminium alloys—cold upsetting, and welded or soldered assemblies. It is not merely a question of one or other of these methods capturing certain types of engineering components from the foundry, but of ingenious combinations of two or more methods being devised by the production engineer to increase output and reduce costs. For example, many small parts once made in the foundry are now being fabricated by the projection-welding of two or more sheet steel pressings, while combinations of extrusion and cold upsetting or press forging are becoming more prevalent.

One very important factor in this drift is the untrammelled outlook of those responsible for the newer metal working methods. There is no tradition which says that this or that cannot be done, and it is partly for this reason that on many occasions orders are lost to the foundry—particularly the brass or bronze foundry—which might have been secured by a greater exercise of initiative from within. Designers may employ a different method of fabrication in redesigning a particular part to reduce weight or cost, when actually a re-designed or improved casting would meet their case as well or better. Rowe[9] quotes an interesting example of this kind of thing:—

> "A certain engineering part had been made in bronze for over 30 years. The use of bronze for this part was universal in the trade and its indispensability for the duty regarded as axiomatic. But a bold spirit in the engineering world, defying tradition, decided that a heat-treated light alloy stamping should be used for this part and his early trials clearly indicated that this was, as compared with the bronze casting, superior. It was only when the bronze founder spent a considerable amount of money in research and discovered that the bronze castings could be made at least 40 per cent. better that the situation was saved for the industry."

Mr. Rowe adds, and the author fully endorses the remark: "Not all such examples end or will end so satisfactorily for the bronze founding industry." The need here is obviously for progress coupled with propaganda to keep engineers and designers fully alive to the advantages that foundrymen can offer in competition with wrought products. It is here that the metallurgist or metallurgical engineer associated with an engineering concern can be most helpful in linking the foundryman and the designer. This point has previously been emphasised by the present author[10] in the following words:—

> "There has been considerable talk of co-operation between the designer and the foundry—of fillets and recesses, cored lugs and changes of section—and although such points as these certainly require full mutual discussion, there is actually a far wider field for co-operation between manufacturer and user than is indicated by these details of casting design. The available methods of production are becoming at the same time so diverse in nature and so complicated in their gradation from one to the other, that it is fast becoming impossible for designers and buyers to keep pace with developments and to make the best possible use of the available production methods. It was once suggested that the right and proper person to provide the necessary link between drawing office and foundry was the metallurgist; this suggestion certainly contains the germ of the truth, but in the view of the present writer much more of the services of the metallurgist or metallurgical engineer of the future will be required in helping to sort out the most appropriate and economical production methods for the components required by the designer, but imperfectly visualised by him in terms of casting or forging, pressing or die-casting, machined stock or extruded or cold-drawn section."

Among all this welter of competitive methods there is one shining example of the foundry industry re-capturing business formerly lost. Pressure die-castings, particularly in the zinc alloys with which considerable intricacy of detail and minimum wall thickness may be obtained, are being employed to an increasing extent in place of sheet metal assemblies, with a reduction in cost, and generally an improvement in finish and appearance. One such die-casting may thus replace two, three or four small pressings and eliminate welding or other joining operations. Motor vehicle radiator grilles, for example, are being die-cast in zinc-base alloys in America by a number of firms, and developments in this line, and probably even more surprising cases of the replacement of sheet metal assemblies, may also be expected very shortly in this country. A further case of carrying the war into the enemy's country is the die-casting of mouldings—such as are now produced by extrusion—in either straight or curved lengths up to 50 in. These may be obtained in the United States in a variety of sections, and are surprisingly thin.

Casting Tubes and Rods

Finally, although it is not perhaps foundry work in the strict sense of the term, one further development which must be referred to as an indication of the trend of events is the production of copper and brass wire rods, tubes and other sections by a continuous casting process. This method,[11] associated with the name of Eldred, is based upon the very careful control of cooling conditions, so that freezing progresses continuously in one direction, the major portion of the heat being removed through the preceding solid metal. By casting these semi-manufactured products, the preliminary hot-working stage, where most difficulty and wastage usually occur, is reduced or eliminated, and the cast shapes have superior properties to those produced by the usual methods. The direct casting of sheet metal is also, of course, being developed in the United States.

Outlook for the Future

Before concluding this survey of the non-ferrous foundry industry, it seems desirable to consider what lies ahead, and what is needed to help in attaining the objectives sought.

It has been shown that increasing precision and control of metal, sand and temperatures are well in evidence, with careful planning taking the place of empirical and individualistic methods. To produce still sounder, stronger and more uniform castings it appears that foundrymen will require a considerable amount of new information on melting practice and on the properties of alloys prepared under ideal conditions, and a fresh outlook on quite a few points, particularly on pouring methods and on the purification of melts by fluxes and other methods. They will need to pay greater attention to casting under pressure, both for low- and high-melting point alloys, and to the advantages obtained with this process, and they can apparently look forward to the development of two new or improved types of technologists—the foundry engineer-cum-metallurgist on one side, and the metallurgical or materials engineer on the other. The future lies to a great extent in the hands of these two, working closely together.

REFERENCES.

1 Murphy. Trans. American Foundrymen's Association, 1935.
2 Gwyer and Dyson. International Association for Testing Materials, London Congress, 1937.
3 Hudson. Proc. Inst. Brit. Foundrymen, 1935–36, Vol. 29, 475 and 155.
4 Hudson. "Metal Industry," 1937, Vol. 50, May 21, 573.
5 Lepp. "Metal Industry," 1935, Vol. 47, Sept. 27 and Oct. 4, 315 and 341.
6 Hutton. Journ. Inst. Metals, 1935, Vol. 57, 31.
7 Lorig and Dayton. Trans. American Foundrymen's Association, 1936.
8 British Non-Ferrous Metals Research Association. Sixteenth Annual Report.
9 Rowe. "Metal Treatment," 1935, No. 1, 13.
10 Hunt. "Metal Industry," 1936, Vol. 48, Jan. 17, 59.
11 Brit. Patent. 461, 471.

Improved Treatment of Fractures

Recommendations for improving the facilities for the treatment of fracture cases are contained in an Interim Report of the Inter-Departmental Committee on the Rehabilitation of Persons Injured by Accidents, published by H.M. Stationery Office, price 4d.

The Report records that the number of fracture cases treated annually in the hospitals of England, Wales and Scotland is well over 200,000. The Committee received information from 825 hospitals in the three countries, of which 724 were voluntary and 101 municipal. In 59 of these there are special fracture departments under a single control, ensuring continuity of treatment until the patient is restored to work; about 50,000 cases are treated annually. The establishment of new fracture services and clinics, the Committee understands, is also being considered in many quarters.

The Report outlines a scheme for a "model clinic," for the assistance of those engaged in the consideration of such proposals. The Committee conclude that the provision of a network of fracture services covering the whole country will call for careful planning to meet local needs and conditions. The co-operation of local authorities, hospitals, the medical profession, and of employers' and workers' organisations will be necessary, and in some areas is already being secured.

James Keith & Blackman

James Keith & Blackman Company, Limited, propose to issue 100,000 £1 5½ per cent. cumulative preference shares and 100,000 10s. ordinary shares. The proceeds of the issue are required to complete the acquisition of a new site for the erection and equipment of a modern factory and for the general expansion of the company's business. It is also proposed to change the name of the company to Keith Blackman, Limited.

Clean Iron

Machine cast iron is *clean*—all iron—free from sand fused on the surface. The absence of the usual siliceous skin exposes the whole surface at once to the melting process, gives quicker melting and requires less coke in the cupola. A fuel saving of quite 20% is common, besides an economy in limestone for fluxing, up to 50%

Machine cast pig iron is uniform throughout the whole cast, easy to handle by hand or magnet; there are no unwieldy sows and the iron can be broken readily as it is notched for this purpose.

Write for the leaflet "Machine Cast Pig Iron" to the Publicity Dept., The United Steel Companies Ltd., 17, Westbourne Road, Sheffield, 10.

THE UNITED STEEL COMPANIES LTD

WORKINGTON

MACHINE CAST PIG IRONS

WORKINGTON IRON & STEEL COMPANY · WORKINGTON · CUMBERLAND

BRANCH OF THE UNITED STEEL COMPANIES LIMITED

W.31

This Week's News in Brief

Trade Talk

STEWARTS AND LLOYDS, LIMITED, Glasgow, are to supply pipework and valves for a pump system at Fulham Borough Council's new power station.

BLACKSTONE & COMPANY, LIMITED, of Stamford, are shortly to open a medical clinic, where all their employees can obtain free medical treatment.

AN ORDER for a twin-screw passenger ship of 195 tons has been received by John Crown & Sons, Limited, of Sunderland, from T. Round & Sons, of Scarborough.

THE STEEL COMPANY OF SCOTLAND, LIMITED, have received an order from the Bengal-Nagpur Railway Administration, India, for the supply of five hundred steel engine tyres.

THE DISCOVERY of tungsten ore deposits in the Wankie area of Rhodesia continues. The initial strike was made a couple of years ago; the first plant, to deal with 150 tons daily, will shortly be in commission.

THE BRUSH ELECTRICAL ENGINEERING COMPANY, LIMITED, Falcon Works, Loughborough, has received an order for a 15,000-kw. (C.M.R.) turbo-alternator set from the Railways Department of the New South Wales Government.

BARTRAM & SONS, LIMITED, Sunderland, have secured an order from Australian owners for a 9,000-ton cargo ship. The engines will be supplied by White's Marine Engineering Company, Limited, of Hebburn-on-Tyne.

THE DIRECTORS of Metal Industries, Limited, entertained 150 members of their Scapa Flow staff at a banquet in celebration of the successful raising of the latest German battleship, "Friedrich Der Grosse."

SIR JAMES LAING & SONS, LIMITED, Sunderland, have received an order from the British Tanker Company, Limited, for a 12,000-ton tanker. The propelling machinery will be supplied by William Doxford & Sons, Limited, Sunderland.

MARSHALL, SONS & COMPANY (SUCCESSORS), LIMITED, of Gainsborough, have declared an interim dividend of 2½ per cent., less income tax, on the share capital of the company, in respect of the financial year ending September 30, 1937.

AT THE ANNUAL GENERAL MEETING of the Institute of Physics it was announced that the following would take office on October 1, 1937:—President, Mr. C. C. Paterson; Vice-President, Prof. W. Makower; honorary treasurer, Major C. E. S. Phillips; honorary secretary, Prof. J. A. Crowther; new members of the Board, Prof. J. Chadwick and Mr. D. C. Gall.

Personal

MR. JOHN SMITH, of the British Aluminium Company, Limited, Kinlochleven, has retired after 34 years' service.

LORD McGOWAN was elected President of the National Safety First Association at the annual meeting in London recently.

MR. HENRY ROBB, a director of Henry Robb, Limited, shipbuilders and engineers, of Leith, has just returned from a business visit to New York.

MR. H. W. HART-BAKER, of Hart Engineering Company, 451, Kiangse Road, Shanghai, would appreciate catalogues and literature covering equipment suitable for a moderate size experimental plant for the eventual manufacturing development of radiators, boilers and malleable light castings.

MR. C. R. LANG, C.B.E., who has completed fifty years' service with G. & J. Weir, Limited, Cathcart, has been presented with gifts from the directors, staff and employees. The presentations were made by Lord Weir. Mr. Lang, who joined the firm as works manager in 1887, is a Whitworth scholar, and studied at the Royal College of Science.

Wills

NEILSON, ALEXANDER, ironmaster, of Glasgow	£138,560
HARE, S., formerly a director of Bolckow Vaughan & Company, Limited ...	£25,713
BATLEY, S. T., director of Greenwood & Batley, Limited, engineers, Leeds ...	£25,265
WHITTAKER, E., of Accrington, director of Whittaker Bros. (Accrington), Limited, ironfounders	£7,831

Company Reports

Consett Iron Company, Limited.—Ordinary dividend of 7½ per cent.

Ferranti, Limited.—Dividend on the 7 per cent. preference stock for the half-year to June 30.

Stewarts and Lloyds of South Africa, Limited.—Half-yearly dividend on the 6 per cent. first cumulative preference shares.

Stanton Ironworks Company, Limited.—Final dividend on the ordinary shares of 6 per cent., making 10 per cent. for the year ended March 31.

Allied Ironfounders, Limited.—Final dividend on the ordinary shares of 6 per cent. (making 10 per cent. for the year to March 31) and a bonus of 1½ per cent.

Bradley & Foster, Limited.—Dividend of 8 per cent. on the ordinary shares, and a final dividend of 7 per cent. (making 10 per cent.), on the preferred ordinary shares.

James Keith & Blackman Company, Limited.—Brought in, £10,160; dividend of 20 per cent. on the ordinary shares; written off freehold land and buildings at Arbroath, £5,000; to reserve, £10,000; carried forward, £13,415.

John Harper & Company, Limited.—Surplus of profit and loss account prior to taxation charges, £48,705; available after preference dividends and interim on ordinary shares, £35,299; final dividend of 11 per cent., making 14 per cent. for the year on the ordinary shares; patterns, patents, etc., written down, £8,299; fixtures, etc., written down, £2,208; carried forward, £7,776.

Triplex Foundry, Limited.—Profit for initial period of seven months ended March 31, £15,845; provided in respect of profits earned prior to incorporation, £3,955; income tax, £4,000; preference dividends, £1,311; payment of 7½ per cent. per annum for the five months to March 31, 1937, on the ordinary shares, £3,516; balance of preliminary expenses, written off, £245; to an employees' fund, £105; carried forward, £2,580.

Anderston Foundry Company, Limited.—Profit for year ended March 31 last, £1,003; brought in, £914; special provision no longer required, £2,322; dividend of 4 per cent.; carried forward, £1,539. The directors propose to distribute 2s. a share out of the investment reserve. This payment is made out of gains realised from the sale of capital investments, and the usual deduction on account of income-tax does not require to be made.

Ruston & Hornsby, Limited.—Balance on trading account for the year, after charging depreciation, making provision for losses on exchange and other contingencies, and including dividends receivable from subsidiary companies, £134,056; dividend from associated company (Ruston-Bucyrus, Limited), £30,000; fees, £1,627; interest on debenture stocks, £21,523; net profit, £140,906; brought in, £59,593; dividend on the 5 per cent. and 6 per cent. preference stocks, £23,500; dividend of 6¼ per cent. on the ordinary stock, £76,875; to general reserve, £50,000; carried forward, £50,124.

Obituary

MR. J. DAVIDSON WHITE, scrap merchant and tube agent, of Stockton-on-Tees, has died.

MR. HARRY WALTER LINDOP, a leading malleable-ironfounder in Walsall, has died at the age of 67.

MR. JOHN BARNSLEY, who died on May 28 at his home in Sheffield, was until a few years ago head of the firm of brassfounders which bore his name, of Excelsior Brass Works, Abbeydale.

MR. ABRAHAM FLOWER JELLYMAN, of Walsall Road, Cannock, has died, in his 80th year. Mr. Jellyman was head of the firm of Samuel Jellyman, ironfounders, of Cannock, with which he had been connected all his working life.

Monel Wire in Cast-Iron Moulds for Glass

Cast-iron moulds used in the glass industry often become defective through the development of pits or cracks, which cause serious flaws in the finished product. If these irregularities or pores are drilled out they may then be plugged with soft Monel wire, and after smoothing off, the mould is again ready for service. Repeated tests have proved that Monel plugs will not become loose, corrode or mark the glass.

Patent Specifications Accepted

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

461,022. STANTON IRONWORKS COMPANY, LIMITED, and CORNELIUS, F. B. Manufacture of pipes and like hollow bodies.

461,040. AKT.-GES. BROWN, BOVERI, & CIE. Impact mills.

461,104. KROSTA, V. Process for the manufacture of precision castings from metals and alloys of high melting point.

461,115. HARDY, INC., C. Refining or alloying of metals.

461,187. UDDEHOLMS AKTIEBOLAG. Ferro alloys.

461,249. DAMAN, A. C. Methods of and means for classifying ores.

461,251. JOHNSON, G. W. (I. G. Farbenindustrie Akt.-Ges.). Steel alloys suitable for parts of apparatus subjected to high temperatures.

461,327. TRIGGS, W. W. (Terni Soc. per l'Industria e l'Elettricita). Process and apparatus for the use of liquid fuel in open-hearth furnaces.

461,370. SADLER, A (Electric Furnace Company). Thermo-couples for use in temperature-control systems of electric furnaces.

461,471. THURSTON, A. P. (White, J. J.). Continuous casting of metal shapes.

461,480. THURSTON, A. P. (Babcock & Wilcox Company). Method of making moulding sand.

461,490. SOC. ANON. D'ESCAUT ET MEUSE. Tube-rolling mills.

461,514. WILLEY & COMPANY, LIMITED, UNITED GAS INDUSTRIES, LIMITED, and HITCHEN, C. H. Protectors or shields for the boots and feet of iron moulders and other workers.

461,552. KRUPP AKT.-GES., F. Corrosion-resistant alloys.

461,736. KRUPP GRUSONWERK AKT.-GES., F. Electrically-driven rollers for roller beds.

461,809. BEMANT, C. Crucible furnaces.

461,952. BOURG, C. Preparing rolled-metal bands for annealing in muffle furnaces.

461,958. BRASSERT & COMPANY, LIMITED, H. A., BRASSERT, H. A., and COLCLOUGH, T. P. Manufacture of steel in the basic-Bessemer converter.

462,059. PITT, M. Blow-pipe machines for cutting metal.

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

Armstrong, Whitworth & Company (Pneumatic Tools), Limited.—Capital, £100. Subscriber: G. Conrad, 103, Phyllis Avenue, New Malden.

I.W.H.T., Limited, Thermoseat Works, Walnut Street, Halifax.—Capital, £3,000. Ironfounders, mechanical engineers, etc. Directors: R. W. Bamforth and J. Bradbury.

Contracts Open

Kegworth, June 12.—100 yds. of 3-in. dia. spun-iron pipes, for the Castle Donington Rural District Council. Elliott & Brown, civil engineers, Burton Buildings, Parliament Street, Nottingham. (Fee £1 1s., returnable.)

Wellington, July 5.—850 cast-iron concrete-lined pipes, 4 in. and 6in. nominal internal diameter unlined, in lengths of 12 ft. Submit alternative prices for vertical or spun cast-iron concrete-lined pipes. Department of Overseas Trade. Reference No. T. 17837/37.

Forthcoming Event

Institute of British Foundrymen
JUNE 17 TO 24.
International Foundry Congress in Paris.

BE WISE — BUY WISE

BUY BRITISH!

Buy PRECISION CHAPLETS & STUDS

AND BE SURE OF GETTING THE BEST. PRECISION PERFORATED CHAPLETS: all shapes, sizes and thicknesses

PRECISION STUDS FOR LIGHT AND HEAVY CASTINGS

●

Also Makers of:—Door Catches • Hinge Tubes and Dovetails for the General Stove and Range Trades • Skimming Gates, Radiator, Nail, Top Hat and every type of Chaplet used in the General Foundry

Remember!

PRECISION CHAPLETS and STUDS FOR BETTER RESULTS

Stockists:
A. LAKIN & SON
TOTLEY RISE,
SHEFFIELD
Phone: Beauchief 70421

PRECISION PRESSWORK CO.

PATENTEES
CLIMAX WORKS, COLESHILL STREET
BIRMINGHAM 4.
Phone: ASTON CROSS 1402 **ESTB. 1874** Grams: "Precico, Phone, Birmingham"

Scottish Representative:
GEO. SMART
59, LUBNAIG ROAD,
GLASGOW, S.3
Phone: Merrylee 3120

WARNER *Special* PIG IRONS

- *Warner C.B.R.*
  and
- *Low Carbon Cylinder*
  (FOR CYLINDERS, ROLLS, ENGINEERING CASTINGS, ETC.)
- *Low Carbon Malleable*
  (FOR MALLEABLE CASTINGS OF ALL DESCRIPTIONS)

Supplied to any specification between limits of 2·00 and 3·50% Carbon and ·50% and 3·50% Silicon

●

ACTUAL ANALYSIS CERTIFICATES ARE AVAILABLE WITH EACH DELIVERY

● **Typical Cylinder Pig Iron Specification**

TOTAL CARBON	2·70%
SILICON	1·80%
MANGANESE	·90%
SULPHUR	·06%
PHOSPHORUS	·40%

● **Typical Malleable Pig Iron Specification**

TOTAL CARBON	2·60%
SILICON	·75%
MANGANESE	·50%
SULPHUR	·05%
PHOSPHORUS	·06%

WARNER & CO. LTD.
MIDDLESBROUGH

Raw Material Markets

So far as can be ascertained at present, it would appear that the revised price list for pig-iron has had little effect on the market other than to allow the renewal of expiring contracts. Producers generally are well booked and are cautious about entering into new commitments, as they already have extensive arrears of deliveries to erase on existing business.

Pig-Iron

MIDDLESBROUGH.—The prices of Cleveland iron, including the additional 20s. per ton which comes into operation on July 1, are 100s. for No. 4 foundry and No. 4 forge, 101s. for No. 3 Cleveland G.M.B., and 103s. 6d. for No. 1 foundry, delivered in the Middlesbrough area. For delivery to Falkirk an extra 3s. per ton is invoiced, while 6s. extra is charged for deliveries on the Clyde. It is expected that old consumers will be able to renew contracts for the third quarter quite satisfactorily, but the tonnage involved will be a matter for the producer to decide and is likely to fall considerably below users' requirements. Shipments of hematite have been on a good scale recently, but customers overseas would willingly take much larger tonnages were supplies available. Home consumers are similarly situated. For delivery in this district, East Coast hematite mixed numbers are quoted at 122s. 6d., less 5s. rebate, while deliveries in Sheffield are charged at 128s. and 133s. 6d. in the Midlands. No. 1 grade is quoted at 6d. per ton extra.

LANCASHIRE.—While a few renewals of contracts have recently been made, deliveries over the second half of the year will continue to be rationed. Thus, the outlook for consumers, who are fully employed, is not a happy one. Offers of Derbyshire and Staffordshire brands of No. 3 foundry iron involving deliveries in the Lancashire price zone over the second half of the year are on the basis of 109s. per ton, with Northants at 107s. 6d. and Derbyshire forge iron at from 104s. to 106s. per ton. For delivery equal to Manchester, Scottish No. 3 foundry iron is quoted at from 135s. to 137s. 6d. West Coast hematite is quoted at 131s. and East Coast material at 130s. 6d. per ton.

MIDLANDS.—It was possible for Northamptonshire producers to enter into business for deliveries up to the end of September at the new prices. Derbyshire makers, however, were already fully sold over this period. Many consumers continue to be inconvenienced by the shortage of iron and supplies of high-phosphoric iron have been purchased from the Continent at £7 15s. to £8 per ton and low-phosphorus iron at £8 to £8 5s. from the United States. For delivery over the second half of the year to Birmingham and Black Country stations, Northants No. 3 iron is 103s. 6d., with Derbyshire, Lincolnshire and North Staffordshire at 2s. 6d. per ton more. Stocks are negligible and there is little prospect of any improvement being brought about in the supply position. Low-phosphorus iron is quoted at £6 5s. and upwards, but there is little available. Refined iron is quoted at £8 and upwards. Some further orders for hematite have been taken, but producers are careful to restrict tonnage. For deliveries to Birmingham and Black Country stations, West Coast mixed numbers are quoted at £6 14s. 6d. and East Coast No. 3 £6 13s. 6d., subject to 5s. rebate.

SCOTLAND.—New business is very difficult to negotiate in this area, as stocks and outputs have been fully accounted for for some time to come. No. 1 foundry iron is quoted at 115s. 6d., with No. 3 at 113s., f.o.t. furnaces. No. 3 Cleveland iron is nominal at 104s. f.o.t. Falkirk and 107s. f.o.r. Glasgow. Steelworks are maintaining a high rate of activity, but the lack of raw materials prohibits any expansion of outputs. Hematite mixed numbers are quoted at 123s., British basic iron at 107s. 6d., and Indian basic 100s. per ton, all delivered steelworks and subject to 5s. per ton rebate.

Coke

Foundry-coke prices remain officially unchanged, but business will only be done at premium figures. Durham coke for delivery to Birmingham and district is quoted at 46s. 6d., but 50s. or 51s. is nearer to the actual price. Welsh coke is quoted at 47s. 6d. to 60s., according to quality.

Steel

The lull in new business in the steel market continues, but it has brought no relief from the insistent pressure on the part of consumers to obtain deliveries from works against existing contracts, says the official report of the London Iron and Steel Exchange. The requirements of the market in practically all departments are well in excess of production, although outputs are maintained at a record rate. The position as regards raw materials is easier owing to extensive foreign purchases of pig-iron and scrap, but the future at the present rate of consumption by the steelworks is not free from anxiety. The situation in the semi-finished steel department is one of great stringency, although large deliveries are being made by the producing works. Arrivals of Continental steel have been on a rather larger scale of late, but operations at many of the consuming works are still restricted by the difficulty of obtaining full supplies. In the finished steel section of the market, the volume of business transacted has been limited by the practical impossibility of placing orders for near delivery. Many consumers would buy far forward, but the steelworks show no disposition to sell beyond the end of the year. Although the export demand has declined somewhat of late, a considerable volume of inquiry continues to reach the British steelmakers.

Scrap

It is reported from the Cleveland area that supplies of scrap are still hard to obtain, and consumers are quite willing to pay the prices fixed under the control scheme, which is now in full operation. A fair tonnage recently arrived from abroad. An undiminished inquiry is also received by South Wales merchants, and the tonnage available falls far short of the demand. Brisk trading for supplies of cast iron and wrought iron is taking place in Yorkshire. All grades of scrap are in active request in the Scottish area, where prices are firm. The tonnage available, however, is insufficient to meet the demand.

Metals

Copper.—The question of the reimposition of restriction continues to be well to the fore in copper circles and it is understood that the matter was discussed at an informal meeting of the Copper Control Committee in London recently. The general opinion would appear to be that restriction will again come into operation when the spot shortage has been overcome. This means that a period of several months must inevitably elapse before there is any possibility of restriction being seriously considered. The market was strengthened by the Prime Minister's decision not to go ahead with his N.D.C. proposals and at times there has been quite a firm tone ruling, with consumers showing just a little more interest in the metal. Most users, however, have large tonnages in stock. In view of the fact that at this time of the year consumers rarely have heavy requirements, buying over the next few months is likely to be quiet. It is reported that production of copper in Canada during the first quarter of the year was the highest for any previous quarter, 41,796,786 lbs. being produced in March alone, while the output for the three months totalled 117,504,602 lbs.

Metal Exchange quotations were as follow :—

Cash.—Thursday, £58 13s. 9d. to £58 15s.; Friday, £57 10s. to £57 15s.; Monday, £59 7s. 6d. to £59 12s. 6d.; Tuesday, £57 10s. to £57 15s.; Wednesday, £57 5s. to £57 7s. 6d.

Three Months. — Thursday, £57 15s. to £57 17s. 6d.; Friday, £56 12s. 6d. to £56 15s.; Monday, £58 7s. 6d. to £58 10s.; Tuesday, £56 15s. to £56 17s. 6d.; Wednesday, £56 12s. 6d. to £56 15s.

Tin.—Unstable conditions have again ruled in this market and prices have fluctuated to a considerable extent. In the United States, labour unrest continues to cause general upheaval to industry and operations at the tinplate mills, which have recently been well over 100 per cent. of normal capacity, have declined to 90 or 95 per cent. A meeting of the International Tin Committee will be held at The Hague to-morrow (Friday), at which it is expected that no change will be made in the export quota for the third quarter of the year.

Baron van Tuyll van Serooskerken, the chairman, at the recent meeting of the Billiton Maatschappij, emphasised the necessity of a more stable tin price and of a buffer pool. He said that the year 1936 had been a favourable one to tin consumption. World consumption rose to almost 90 per cent. of the 1929 consumption, the highest year on record. It had been very difficult for the International Committee to fix the production quotas so as to meet this rapidly increasing demand, mainly through uncertainty about Bolivian exports. Nevertheless, it had succeeded in adjusting stocks better to the higher consumption level. As regards prices, it could not be said that the International Tin Committee had controlled the position. In spite of the existence of reasonable stocks the market had shown an irregular aspect. It was regrettable that tin producers should not be making every effort to prevent such unnecessary fluctuations, for price stabilisation was in the interests alike of producers and consumers. In fact, too high prices would, in the long run, cause permanent harm to consumption. Baron van Tuyll stressed that the means to adjust production to consumption—namely, alteration of quota—did not work quickly enough to prevent severe oscillations of prices. In order to comply with Article 1 of the agreement of the International Tin Control scheme, it would be necessary to apply yet another measure, either in the form of stocks the International Tin Committee could have at its disposal or in another form, in order to arrive at more or less stable prices. This would be in the interests both of producers and consumers.

Official quotations were as follow :—

Cash.—Thursday, £253 5s. to £253 10s.; Friday, £251 to £251 5s.; Monday, £253 10s. to £253 15s.; Tuesday, £251 to £251 5s.; Wednesday, £252 to £252 5s.

Three Months.—Thursday, £251 15s. to £252; Friday, £249 15s. to £250; Monday, £252 10s. to £252 15s.; Tuesday, £249 15s. to £250 5s.; Wednesday, £250 10s. to £250 15s.

Spelter.—Rather featureless and uninteresting conditions have prevailed during the past week. There is little likelihood of any appreciable increase in the demand at the present time, as most consumers have adequate stocks to tide them over a considerable period.

Daily market prices :—

Ordinary.—Thursday, £22 13s. 9d.; Friday, £22 3s. 9d.; Monday, £22 16s. 3d.; Tuesday, £22; Wednesday, £21 17s. 6d.

Lead.—World production of lead (exclusive of Spain) during April, as reported by the American Bureau of Metal Statistics, was 151,600 tons, compared with 146,700 tons (exclusive of Italy and Spain) in March. The market has been steady recently and the undertone is quite sound.

Day-to-day quotations :—

Soft Foreign (Prompt).—Thursday, £23 17s. 6d.; Friday, £23 17s. 6d.; Monday, £24 1s. 3d.; Tuesday, £23 7s. 6d.; Wednesday, £22 17s. 6d.

WHEN THINKING OF
SANDBLAST
THINK OF
RICHARDSON'S
Established 1887.
We Supply Re-Conditioned & New
SAND BLAST PLANTS
AND
AIR COMPRESSORS.
Tilghman's, Room, Barrel, Chamber, Rotary Table, Dust Arrester, and Continuous Feed Barrel Plants.
Phone: MIDLAND 2251.
Grams: "SANDBLAST, B'HAM."
R. J. RICHARDSON & SONS, Ltd.,
Commercial Street, Birmingham.

For **"easy stripping"** use

YORKSHIRE SAND

Yorkshire Sand is of a synthetic nature, its production being under careful laboratory control. Perfect standardization is obtained with the various grades, suitable for light and the heaviest steel castings.

It is because of the refractoriness of the sand and of the toughness of the mould surface that castings made with Yorkshire Sand are distinguishable by their excellent finish.

Please address all enquiries to the nearest Sales Office :

GENERAL REFRACTORIES LTD.,

Genefax House, Sheffield

Telephone : *Sheffield 31113 (6 lines).*

Telegrams : *"Genefax, Sheffield."*

LONDON OFFICE: Russell House, Adelphi, W.C.2.
Telephone: Temple Bar 7361. Telegrams: "Genefax, Rand-London." Mr. A. C. Turner.

SCOTTISH OFFICE: 48, West Regent Street, Glasgow. Telephone: 3009. Telegrams: "Genefax, Glasgow." (Mr. C. A. G. Thomson.)

MANCHESTER OFFICE: 9, Albert Square, Manchester, 2. Telephone: Blackfriars 6130. Telegrams: "Genefax, Manchester." (Mr. S. G. Throssell.)

SWANSEA OFFICE: Metropole Chambers, Wind Street, Swansea. Telephone: 3680. Telegrams: "Genefax, Swansea." (Mr. D. Hood-Williams.)

CARDIFF OFFICE: 17, Windsor Place, Cardiff. Telephone: 5796. Telegrams: "Genefax, Cardiff." (Mr. F. E. Rutter.)

MIDDLESBROUGH OFFICE: Halifax Buildings, Exchange Place.
Telephone: Middlesbrough 3313. Telegrams: "Genefax, Middlesbrough.

★

Read what an IMPORTANT STEELFOUNDER says :—

"During the 40 years I have been connected with Steel Foundry work, considerable changes have taken place. Away back, we had Steel Moulders' Composition, Old Crucible Pots, etc., and each works claimed to have its own 'secret' moulding composition. High Silica Sand has eliminated practically all these from many foundries and to-day we have your 'Yorkshire Sand' which acts almost like a chill, and leaves the skin of the casting blue-black and as clean as cast iron.

The hot steel lies quietly against the wall of sand, and often when the casting has been lifted out of the mould, the latter looks as if it could be used over again, just like a permanent mould."

RAW MATERIALS—PRICE LIST

(Wednesday, June 9, 1937)

COPPER

	£	s.	d.
Standard cash	57	5	0
Three months	56	12	6
Electrolytic	62	0	0
Tough	62	5	0
Best selected	62	15	0
Sheets	93	0	0
India	75	10	0
Wire bars	64	0	0
Ingot bars	64	0	0
H.C. wire rods	67	10	0
Off. av. cash, May	61	4	8 1/16
Do., 3 mths., May	58	6	4 7/32
Do., Sttlmnt., May	61	3	5 1/16
Do., Electro, May	64	13	5 1/16
Do., B.S., May	65	0	0
Do., wire bars, May	65	13	1 17/16
Solid drawn tubes			14½d.
Brazed tubes			14½d.
Wire			10½d.

BRASS

Solid drawn tubes	12½d.
Brazed tubes	14½d.
Rods, drawn	11d.
Rods, extd. or rlld.	7½d.
Sheets to 10 w.g.	10½d.
Wire	10d.
Rolled metal	9½d.
Yellow metal rods	7½d.

TIN

	£	s.	d.
Standard cash	252	0	0
Three months	250	10	0
English	252	0	0
Bars	254	5	0
Straits	253	10	0
Eastern	252	12	6
Banca (nom.)	253	10	0
Off. av. cash, May	250	16	11 13/16
Do., 3 mths., May	248	12	8 7/16
Do., Sttlmt., May	250	16	10 2/16

SPELTER

	£	s.	d.
Ordinary	21	17	6
Remelted	20	0	0
Hard	19	0	0
Electro, 99.9	24	10	0
English	23	5	0
India	20	0	0
Zinc dust	32	0	0
Zinc ashes	8	15	0
Off. aver., May	23	4	6 33/32
Aver. spot, May	23	1	10 3/16

LEAD

	£	s.	d.
Soft foreign, ppt.	22	17	6
Empire (nom.)	24	2	6
English	25	0	0
Off. aver., May	23	18	10 31/32
Aver. spot, May	24	0	0

ALUMINIUM

Ingots	£100 to £105
Wire	1/3 to 1/4 lb.
Sheet and foil	1/2 to 1/4 lb.

ZINC SHEETS, &c.

	£	s.	d.	£	s.	d.
Zinc sheets, English	35	10	0 to	36	0	0
Do., V.M. ex-whse.	35	10	0 to	36	0	0
Rods				30	0	0

ANTIMONY

	£	s.	d.	£	s.	d.
English	82	10	0 to	83	10	0
Chinese, ex-whse.				69	0	0
Crude, c.i.f.				36	10	0

QUICKSILVER

	£	s.	d.
Quicksilver	15	5	3

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—			
25%	12 10 0 to 14 0 0		(nom.)
45/50%	10 15 0 to 12 0 0		(nom.)
75%	15 15 0 to 17 0 0		(nom.)
Ferro-vanadium—			
35/50%			12/8 lb. Va
Ferro-molybdenum—			
70/75% carbon-free			4/9 lb. Mo.
Ferro-titanium—			
20/25% carbon-free			9d. lb.
Ferro-phosphorus, 20/25%			£21 to £22
Ferro-tungsten—			
80/85%			5/- lb. (nom.)
Tungsten metal powder—			
98/99%			5/3 lb. (nom.)
Ferro-chrome—			
2/4% car.	32	17	6
4/6% car.	22	10	0
6/8% car.	21	10	0
8/10% car.	21	10	0
Ferro-chrome—			
Max. 2% car.	32	10	0
Max. 1% car.	35	15	0
Max. 0.5% car.	36	10	0
70% carbon-free	9½d. lb.		
Nickel—99.5/100%	£180 to £185		
"F" nickel shot	£165	0	0
Ferro-cobalt, 98/99%	8/6 lb.		
Metallic chromium—			
96/98%	2/5 lb.		
Ferro-manganese—			
76/80% loose	£16 15 0 to 17 5 0		
76/80% packed	£17 15 0 to 18 5 0		
76/80% export	£20 0 0		
Metallic manganese—			
94/96% carbon-free	1/3 lb.		

Per ton unless otherwise stated, basis 2-ton lots.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	2s. 7d.
Finished bars, 18% tungsten	3s. 6d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ¼ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 7/16 in.	1/- lb.
Flats, ¼ in. × ¼ in. to under 1 in. × ⅜ in.	3d. lb.
Do., under ¼ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.
Bars cut to length, 10% extra.	

SCRAP

	£	s.	d.	£	s.	d.
South Wales (West)—						
Heavy steel, best	3	7	6 to	3	10	0
Mixed iron and steel	3	5	0 to	3	7	6
Heavy cast iron	3	8	0 to	3	10	0
Good machinery				4	2	6
Cleveland—						
Heavy steel, best	3	6	6 to	3	9	0
Steel turnings				2	15	0
Heavy cast iron				4	5	0
Heavy machinery				4	10	0
Midlands—						
Short heavy steel	3	15	0 to	4	0	0
Light cast-iron scrap				3	5	0
Heavy wrought iron	4	0	0 to	4	5	0
Steel turnings	2	2	6 to	2	5	0
Scotland—						
Heavy steel, best	3	4	6 to	3	7	0
Ordinary cast iron				4	10	0
Cast-iron borings	2	0	0 to	2	2	6
Wrot-iron piling				4	7	6
Heavy machinery	4	15	0 to	4	17	6

London—Merchants' buying prices, delivered yard.

	£	s.	d.
Copper (clean)	47	0	0
Brass	30	0	0
Lead (less usual draft)	19	10	0
Tea lead	13	10	0
Zinc	14	15	0
New aluminium cuttings	74	0	0
Braziery copper	42	0	0
Gunmetal	45	0	0
Hollow pewter	160	0	0
Shaped black pewter	115	0	0

PIG-IRON

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	83/6
,, No. 3	81/-
,, No. 4	80/-
Forge No. 4	80/-
Hematite No. 1	123/-*
Hematite M/Nos.	122/6*
N.W. Coast—	
Hem. M/Nos. d/d Glas.	123/-*
,, d/d Birm.	134/6*
Malleable iron d/d Birm.	160/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	83/-
,, No. 3 fdry.	86/-
Northants forge	80/6
,, fdry. No. 3	83/6
,, fdry. No. 1	86/6
Derbyshire forge	83/-
,, fdry. No. 3	86/-
,, fdry. No. 1	89/-
Scotland—	
Foundry, No. 1, f.o.t.	115/6
,, No. 3, f.o.t.	113/-
Cleveland No. 3, Glasgow	87/-
,, ,, Falkirk	84/-
Scottish hem. M/Nos. d/d	123/-*
Sheffield (d/d district)—	
Derby forge	80/6
,, fdry. No. 3	83/6
Lincs forge	80/6
,, fdry. No. 3	83/6
W.C. hematite	128/6*
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	89/-
Staffs fdry. No. 3	89/-
Northants fdry. No. 3	87/6
Cleveland fdry. No. 3	89/-
Glengarnock, No. 3	137/6
Clyde, No. 3	137/6
Monkland, No. 3	137/6
Summerlee, No. 3	137/6
Eglinton, No. 3	137/6
Gartsherrie, No. 3	137/6
Shotts, No. 3	137/6

* Subject to a rebate of 5s. per ton under certain conditions.

FINISHED IRON AND STEEL

Usual district deliveries for iron; delivered consumers' station for steel.

[A rebate of 15/- per ton for steel sections, plates and joists is obtainable in the home trade under certain conditions.]

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)				11	17	6
Nut and bolt iron	10	5	0 to	10	15	0
Hoops				12	15	0
Marked bars (Staffs) f.o.t.				14	7	6
Gas strip				12	15	0
Bolts and nuts, ¾ in. × 4 in.				17	10	0 and up.
Steel—						
Plates, ship, etc.	11	8	0 to	11	10	6
Boiler plts.	11	18	0 to	12	0	6
Chequer plts.				13	0	6
Angles				11	0	6
Tees				12	0	6
Joists				11	0	6
Rounds and squares, 3 in. to 5½ in.				12	0	6
Rounds under 3 in. to ¾ in. (Untested)				11	9	0
Flats—8 in. wide and over				11	5	6
,, under 8 in. and over 5 in.				11	10	6
Rails, heavy				10	2	6
Fishplates				14	2	6
Hoops (Staffs)				12	4	0
Black sheets, 24g. (4-t. lots)				15	15	0
Galv. cor. shts. (,,)				19	10	0
Galv. flat shts. (,,)				20	0	0
Galv. fencing wire, 8g. plain				17	10	0
Billets, soft, 100-ton lots				7	17	6
Sheet bars				7	15	0
Tin bars				7	16	0

PHOSPHOR BRONZE

	Per lb. basis
Strip	13½d.
Sheet to 10 w.g.	14½d.
Wire	15½d.
Rods	15½d.
Tubes	20½d.
Castings	16d.

Delivery 3 cwt. free.
10% phos. cop. £33 above B.S.
15% phos. cop £38 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5½
Ingots rolled to spoon size	1/- to 1/8½
Wire round—	
to 10g.	1/6½ to 2/1½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/5½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	25.76
No. 2 foundry, Valley	24.00
No. 2 foundry, Birm.	20.38
Basic, Valley	23.50
Malleable, Valley	24.00
Grey forge, Valley	23.50
Ferro-mang. 80%, seaboard	102.50
O.-h. rails, h'y, at mill	42.50
Billets	37.00
Sheet bars	37.00
Wire rods	47.00
	Cents.
Iron bars, Chicago	2.40
Steel bars	2.45
Tank plates	2.25
Beams, etc.	2.15
Skelp, grooved steel	2.10
Steel hoops	2.40
Sheets, black, No. 24	2.40
Sheets, galv., No. 24	3.80
Wire nails	2.75
Plain wire	2.90
Barbed wire, galv.	3.40
Tinplates, 100-lb box	$5.35

COKE (at ovens)

Welsh foundry	32/- to 33/-
,, furnace	27/- to 28/-
Durham foundry	35/6
,, furnace	37/6
Scotland foundry	—
,, furnace	28/-

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box		24/6 to 25/6
,,	28×20	,,	49/- to 51/-
,,	20×10	,,	34/6 to 35/6
,,	18¾×14	,,	24/9 to 25/9
C.W.	20×14	,,	22/- to 23/-
,,	28×20	,,	45/- to 46/6
,,	20×10	,,	31/- to 32/6
,,	18¾×14	,,	23/- to 25/-

SWEDISH CHARCOAL IRON & STEEL

Pig-iron	£12	0	0 to	£13	0	0
Bars-hammered, basis	£20	0	0 to	£21	0	0
Bars and nail-rods, rolled, basis	£19	0	0 to	£20	0	0
Blooms	£16	0	0 to	£17	0	0
Keg steel	£27	0	0 to	£30	0	0
Faggot steel	£20	0	0 to	£25	0	0
Bars and rods dead soft st'l	£19	0	0 to	£20	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 19.39 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

	£ s. d.	
June 3 ..	58 13 9	dec. 51/3
,, 4 ..	57 10 0	,, 23/9
,, 7 ..	59 7 6	inc. 37/6
,, 8 ..	57 10 0	dec. 37/6
,, 9 ..	57 5 0	,, 5/-

Electrolytic Copper

	£ s. d	
June 3 ..	63 0 0	dec. 20/-
,, 4 ..	62 0 0	,, 20/-
,, 7 ..	63 0 0	inc. 20/-
,, 8 ..	62 0 0	dec. 20/-
,, 9 ..	62 0 0	No change

Standard Tin (cash)

	£ s. d.	
June 3 ..	253 5 0	dec. 35/-
,, 4 ..	251 0 0	,, 45/-
,, 7 ..	253 10 0	inc. 50/-
,, 8 ..	251 0 0	dec. 50/-
,, 9 ..	252 0 0	inc. 20/-

Tin (English ingots)

	£ s. d.	
June 3 ..	253 5 0	dec. 40/-
,, 4 ..	251 0 0	,, 45/-
,, 7 ..	253 10 0	inc. 50/-
,, 8 ..	251 5 0	dec. 45/-
,, 9 ..	252 0 0	inc. 15/-

Spelter (ordinary)

	£ s. d.	
June 3 ..	22 13 9	dec. 18/9
,, 4 ..	22 3 9	,, 10/-
,, 7 ..	22 16 3	inc. 12/6
,, 8 ..	22 0 0	dec. 16/3
,, 9 ..	21 17 6	,, 2/6

Spelter (Electro, 99.9 per cent.)

	£ s. d.	
June 3 ..	25 16 3	dec. 5/-
,, 4 ..	24 16 3	,, 20/-
,, 7 ..	25 8 9	inc. 12/6
,, 8 ..	24 12 6	dec. 16/3
,, 9 ..	24 10 0	,, 2/6

Lead (soft foreign, prompt)

	£ s. d.	
June 3 ..	23 17 6	dec. 11/3
,, 4 ..	23 17 6	No change
,, 7 ..	24 1 3	inc. 3/9
,, 8 ..	23 7 6	dec. 13/9
,, 9 ..	22 17 6	,, 10/-

Lead (English)

	£ s. d.	
June 3 ..	26 0 0	dec. 10/-
,, 4 ..	26 0 0	No change
,, 7 ..	26 0 0	,, ,,
,, 8 ..	25 10 0	dec. 10/-
,, 9 ..	25 0 0	,, 10/-

AVERAGE MONTHLY PRICES OF STEEL RAILS

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1922	9 10 0	9 10 0	9 10 0	9 10 0	9 10 0	9 10 0	9 10 0	9 0 0	8 15 0	8 15 0	8 15 0	8 15 0	9 4 2
1923	8 17 6	9 2 0	10 5 0	10 10 0	10 10 0	10 10 0	9 15 0	9 0 0	8 15 0	8 15 0	8 19 0	9 5 0	9 9 10
1924	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 2 6	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 2 3½
1925	9 0 0	9 0 0	9 0 0	8 15 0	8 10 7½	8 10 0	8 10 0	8 10 0	8 10 0	8 4 0	8 0 0	8 0 0	8 11 7½
1926	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 7 6	8 10 0	8 10 0	8 10 0	8 10 0	8 3 11½
1927	8 10 0	8 10 0	8 10 0	8 2 6	8 2 6	8 2 6	8 2 6	8 2 6	8 2 6	8 3 0	8 5 0	8 5 0	8 4 10
1928	8 5 0	8 5 0	8 5 0	8 5 9	8 6 3	8 6 3	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 7 9½
1929	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0
1930	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0
1931	8 9 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 8
1932	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6
1933	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6
1934	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6
1935	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6
1936	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6
1937	8 7 6	8 7 6	8 7 6	8 7 6	10 2 6	—	—	—	—	—	—	—	—

AVERAGE MONTHLY PRICES OF EAST COAST HEMATITE AT MIDDLESBROUGH

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1921	240 0	220 0	180 0	180 0	180 0	160 0	160 0	160 0	137 0	127 6	117 6	104 6	162 2
1922	97 6	91 7½	100 0	98 6	97 1½	94 7	93 6	90 9	89 7	91 10½	93 0	93 2	94 5½
1923	94 6	104 9	122 0	126 10½	122 0	115 3	107 0	98 8½	98 10½	99 1½	100 6½	102 3	107 10½
1924	102 4½	101 3	99 7½	99 0	98 9½	97 4½	95 8½	93 1½	90 7½	88 0	88 4½	88 6	95 2½
1925	87 5	85 9	84 7½	82 6	80 10½	79 3	77 1½	75 7½	75 0	74 3½	74 9	76 0	79 5½
1926	77 3	77 9	77 3½	76 3	77 4½	78 0	79 8½	81 9	83 4½	87 7½	92 6	90 5½	81 7½
1927	90	90 0	86 3½	83 1½	80 6	78 0	76 6	75 4½	75 0	72 9	71 9	71 1½	79 2½
1928	69 7½	69 9	69 9	70 0	70 0	69 3	68 7½	69 2	70 0	70 0	70 3	71 0	69 9½
1929	71 6	72 0	73 6	74 0	74 0	74 1½	74 9	75 6	76 1½	76 8½	78 1½	79 0	74 11½
1930	78 2½	78 0	76 9	75 0	74 0	72 7½	71 0	71 0	71 0	71 0	70 10½	70 4½	73 3½
1931	70 0	69 0	68 0	66 8½	65 1½	63 4½	62 9	61 1½	65 0	65 0	65 0	65 0	65 6
1932	64 10	64 3	63 6	63 6	63 6	62 7½	62 0	60 6	60 0	59 3	59 0	59 0	61 10
1933	59 0	59 0	59 0	59 0	59 0	59 0	59 0	59 0	59 3	60 7½	62 6	62 6	59 8½
1934*	62 6	65 0	67 6	67 6	67 6	67 6	67 6	67 6	68 0	68 6	68 6	68 6	67 2
1935*	69 0	69 0	69 0	69 0	69 0	69 0	70 1½	71 0	71 0	71 0	71 0	71 0	70 1
1936*	71 0	76 3	77 0	77 0	77 10½	80 6	85 6	85 6	85 6	85 6	85 6	88 0	81 3½
1937*	98 0	98 0	98 0	98 0	123 0	—	—	—	—	—	—	—	—

* Since March, 1934, delivered works; previously f.o.t. furnaces. NOTE.—Prices of hematite have since July 1, 1936, been subject to a rebate of 5s. under certain conditions.

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

PIG IRON

REGISTERED TRADE MARK

FOR EVERY TYPE OF CASTING

NON-FERROUS METALS

REFRACTORIES — COKE — SAND

FERRO-SILICON—FERRO-CHROME

WILLIAM JACKS & COMPANY,

CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.

ZETLAND ROAD, MIDDLESBROUGH.

SITUATIONS VACANT AND WANTED

AN Executive, having a wide practical experience of the production and heat-treatment of electric steel castings is required by a large Australian foundry. Full personal details of experience to be submitted to: Box 426, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PROGRESSIVE Foundry Manager desires change. Broad experience in machine-tool and general engineering castings, also modern production plant. At present engaged in marine and non-ferrous castings. Fully capable of taking entire charge and guarantee results. Would consider position home or abroad.—Box 428, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

APPLICATIONS are invited for the post of Chief Metallurgist with old-established firm of progressive hydraulic engineers having well-equipped laboratory and operating iron and brass foundries in the West of Scotland. The position offers excellent opportunities to the right man. Applicants should be over 30 years of age and will be required to instigate research work. Apply in confidence, giving full particulars of experience, qualifications, and salary expected.—Box 420, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

ASSISTANT Metallurgical Chemist, preferably with knowledge of ferrous alloys, required by firm in Rugby district. Applicants should state age, previous experience, and salary required.—Apply: Box 422, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

HEAD FOREMAN required for steel foundry in the North-East area; capacity 70 tons weekly. To supervise all sections of production, moulding, core-making and fettling. Must have organising ability and experience of mass production of high-grade precision castings. Apply stating age and experience.—Box 416, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

DAVID BROWN & SONS (HUDD), LTD., Huddersfield, require immediately for their Penistone Foundry:—

STEEL FETTLING SHOP FOREMAN for supervision of steel dressing, shot blasting, acetylene cutters, arc welding, annealing and heat-treatment. Preference given to one familiar with piecework rates and bonus system. Mark envelope "Steel Fettling Shop Foreman."

FOUNDRY ASSISTANT FOREMAN for supervision of melting, casting and moulding, and core-making in steel foundry. Must have good experience in light and medium steel casting work. Mark envelope "Foundry Assistant Foreman."

FOUNDRY ASSISTANT FOREMAN, preferably member of I.B.F., for supervision of moulding. Good practical training essential plus some technical knowledge, and must have good experience in general jobbing work and machine-tool castings. Mark envelope "Foundry Assistant Foreman."

Each of the three foregoing positions offer considerable scope for energetic men possessed of initiative. There is good bonus system and Staff Pensions and Insurance Scheme. Houses available.

All applications relating to these advertisements should be addressed in the first instance to PERSONNEL MANAGER, DAVID BROWN & SONS, (HUDD), LTD., Huddersfield.

FOUNDRY ASSISTANT required for N.E. Coast firm, must have modern practical moulding and foundry experience, also theoretical metallurgical training. Permanent position likely for suitable young applicant. Write stating salary and experience to: Box ZR673, c/o DEACON'S, 5, St. Mary Axe, E.C.3.

MACHINERY

WANTED.—A complete second-hand Cupola, shell dia. 8 ft. minimum. State full dimensions and price.—Box 418, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WANTED.—Latest type BMC 240 "Ronceray" continuous Sand Rubbing Machine. State price and condition.—Box 414, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PIERCY & CO., LTD.,
GT. TINDAL STREET,
BIRMINGHAM

SURPLUS Foundry Plant for Sale, including Jackman Sandblast Table and Core Stoves; Tilghman Sandblast Barrels; Receiving Tank; Sand Drier; August Borrman Core Blowing Machine; Broom & Wade Air Compressor, etc. Can be inspected at above address. Real bargains for quick sale.

SAND MIXERS AND AERATORS.—The "Breakir" Centrifugal Machine is *THE* machine. Outputs 10 cwts. to 8 tons per hr.—W. BREALEY & Co., LTD., Station Works, Ecclesfield, Sheffield.

'Phone 98 Staines.

76-H.P. Petter Crude-Oil Engine with 230-volt dynamo.
Weir Boiler Feed Pump, 10,800 galls. per hr.
Briquette Mixing, Extruding and Cutting-off Machine.
18-ft. Centres Chain Bucket Coal Elevator.
Double-Roll Stone Crusher, rolls, 36 in. by 14 in.
Robey Vertical Air Compressor, 850 c.f. at 30 lbs.
5-in. Isler Turbine Pump, 220-ft. head.
Tangye Three-throw Ram Pump, 9½ in. by 12-in. rams.

HARRY H. GARDAM & CO., LTD.,
STAINES.

ELECTRIC CUPOLA BLOWERS (large stock), including two 50-h.p. 3/50/400 volts, 2,900 r.p.m.; Keith Blackman; 12-in. outlet.
30-h.p. ditto; 12-in. outlet.
5-h.p. ditto; 6-in. outlet.
20-h.p. 460 volts d.c., 2,400/1,900 r.p.m.; 10-in. outlet.
EXHAUST FANS (large stock), electrical and belt driven.
ELECTRIC RUNWAY LIFTING BLOCKS:
One 4½-ton 460 volts d.c., Vaughan.
Two 2-ton ditto, Morris.
One ½-ton 220 volts d.c., Morris (as new).
One ½-ton 3/50/440 volts, Aabacas.
Two Reavell Rotary Compressors, 12 lbs. sq. in. pressure: 750 cub. ft. direct-coupled on bedplate to 60 h.p. S.R., 3/50/400 volts motor.
½-cwt. Pilkington Self-contained Pneumatic Hammer.
Geared Foundry Ladles, 9, 4, 3½, 2½ and 1 ton, etc.
AIR COMPRESSORS: 30 in stock in sizes 500 to 20 cub. ft.
ELECTRIC MOTORS: Large stock to suit almost all electric systems.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.
CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham.
'Phone: Broadwell 1359.

THOS. W. WARD LTD.

75-h.p. "Holt" TRACTOR.
75′ STEEL SOCKETED PIPING, 24″ dia. in 25′ lengths.
2,000′ 2″ dia. S. & S. PIPING.
Two 10/12-ton ballast Barford & Perkins PETROL ROLLERS.
Write for "Albion" Catalogue.
'Grams: "Forward." 'Phone: 23001 (10 lines).
ALBION WORKS, SHEFFIELD.

MACHINERY—*Continued*

BAKER Blower, size 25, 140 r.p.m., 3,500 cub. ft. per min., pressure 1½ lbs., 25 cub. ft. displacement per revolution. It is capable of melting 8 tons per hr. in a 40/48-in. cupola or supplying fifty smith's fires at 70 cub. ft. per fire. The machine is dismantled, but we would guarantee it being in order. £30 on site (dismantled).—Apply: EDWARD LUCAS & SON, LTD., Dronfield, near Sheffield.

FOR SALE.—Several M.R.V. and Morgan Tilting Furnaces suitable for brass and bronze melting. Wanted.—Several good Cupolas, large size.—Box 424, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

NEW Dwarf Cupola, to melt 10 to 15 cwts. per hr. New Worm-geared Ladles, 5 tons, 25 cwts., 15 cwts. and 10 cwts. capacity. Ungeared Ladles, 15 cwts. and 10 cwts. capacity. Improved Cupola Spark Arresters.—T. DAVIES & SON, West Gorton, Manchester.

MISCELLANEOUS

BLACK-HEART Malleable Castings for all trades supplied; good delivery. Inquiries solicited.—Box 404, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

GENUINE Southport Wind Blown Sand, which makes best oil-sand cores. Prompt deliveries by road into works.

JOHN LIVESEY,
SAND MERCHANT,
SOUTHPORT.

PATTERN MAKING of all descriptions. Specialists in snap-flask timbers.—THE BEDFORD PATTERN MAKING CO., Ampthill Road, Bedford. 'Phone: 2895.

FLUIDITY TESTS.—Patterns for these tests as described in F.T.J. of September 24 by Carl F. Joseph. Made in aluminium from our master pattern. 35s per set. We shall also be glad to have your inquiries for patterns in hard or soft woods for all kinds of engineering, large and small.—FURMSTON & LAWLOR, Pattern Makers, Letchworth.

PUBLICATION

RYLAND'S DIRECTORY of the Coal, Iron, Steel, Tinplate, Metal, Engineering, Hardware and Allied Trades. 1936 edition completely out of print. Next edition 1938. Price 42s. cloth bound. Order your copy now.—INDUSTRIAL NEWSPAPERS, LIMITED, 49, Wellington Street, Strand, London, W.C.2.

'Phone: 297 SLOUGH

NEW 30″ × 36″ Tilghman Sandblast Barrel Plant complete. £96

12′ square Tilghman Sandblast Room with apparatus complete. CHEAP.

30″ dia., Jackman CUPOLETTE on trunnions, as new. £28.

Modern 440-lb. Morgan oil-fired Tilting Furnace with enclosed gears and new Morgan Burner. £75

Nearly new Tabor jolt squeeze pattern draw Moulding Machine. £60.

PLEASE SEND FOR OUR LATEST CATALOGUE.

ALEX. HAMMOND, *Foundry Machinery Merchant.*
14, AUSTRALIA ROAD, SLOUGH
BUY FROM ME AND SAVE MONEY!